AR TARGET SHEET

The following document was too large to scan as one unit, therefore, it has been broken down into sections.

EDMC#: 0061511
SECTION: 1 OF 5

DOCUMENT #: RPP-13774, Rev 002

TITLE: SST System Closure Plan

U.S. Department of Energy
Office of River Protection
P.O. Box 450
Richland, Washington 99352

0061511

MAR 29 2004

04-ED-024

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 W. Fourth Avenue
Kennewick, Washington 99336

Dear Mr. Wilson:

SUBMITTAL OF CLASS 2 PERMIT MODIFICATION REQUEST FOR THE WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP)

References:
1. Hanford Facility RCRA Permit, WA7890008967, Chapter 10, and Attachment 51, Waste Treatment and Immobilization Plant.
2. Technical Basis for Classification of Low-Activity Waste from Hanford Site Tanks, WCH-SD-WM-TI-699, Revision 2, dated September 1996.
3. NRC letter from C. J. Paperiello to J. E. Kinzer, RL, "Classification of Hanford Low-Activity Waste Fraction," dated June 9, 1997.

This letter transmits a Class 2 permit modification request to the above Permit (Reference 1). The proposed permit modification includes:

- Update of elements of Attachment 51 to incorporate compliance schedule packages;
- Incorporation of the new WTP configuration of two high-level waste (HLW) melters and two low-activity waste (LAW) melters; and
- Elimination of the technetium ion exchange system from the pretreatment (PT) facility.

Each of these is briefly discussed below.

Update of Elements of Attachment 51 to Incorporate Compliance Schedule Packages.

Since the Permit was initially issued in September 2002, thirty-five compliance schedule packages have been incorporated into the Permit by the State of Washington Department of Ecology (Ecology). These packages addressed secondary containment systems, tank systems, containment buildings, and container storage throughout the WTP. Consistent with the requirement to submit information for the Hanford Resource Conservation and Recovery Act (RCRA) Facility Permit renewal, this modification aligns the text portions of Attachment 51, Chapters 1, 2, 4, and Appendices 4A and 6A with these approved packages. In addition, Chapter 4 is being revised in support of the Hanford RCRA Facility Permit renewal. Narrative descriptions, tables, and figures associated with regulated systems of the WTP that have not yet been the subject of compliance schedule packages have been updated.

Incorporation of the New WTP Configuration of Two HLW Melters and Two LAW Melters.

This modification proposes to change the configuration of the WTP from three LAW melters and one HLW melter to two LAW melters and two HLW melters.

The Hanford Federal Facility Agreement and Consent Order (HFFACO) milestone date for completion of waste processing is 2028. An analysis of options was performed to maximize the opportunity to use the WTP to complete this waste cleanup mission at Hanford. It was determined that the first step to accelerate Hanford waste processing to meet the HFFACO milestone of 2028 was to increase initial HLW throughput by completing the second melter line in the WTP. Results of significant research and technology, flowsheet analysis, process modeling, and design evolution were used in the analysis. Based on this analysis, the WTP configuration of two HLW and two LAW melters meets the initial performance requirements and provides the opportunity to optimize LAW treatment with supplemental facilities to efficiently complete Hanford's tank waste clean-up mission.

Elimination of the Technetium Ion Exchange System from the PT Facility.

The Part B permit application submitted in December 2001 included technetium removal through ion exchange as a process step. Technetium removal was not provided to comply with dangerous waste regulations or specifically treat a dangerous waste component of tank waste, a mixed waste, but was provided to remove a radioactive constituent regulated by the U.S. Department of Energy (DOE) under the Atomic Energy Act of 1954 (AEA). The decision not to incorporate a technetium removal system in the WTP is consistent with DOE's 1996 technical analysis (Reference 2) regarding tank waste pretreatment. That analysis indicated, to the satisfaction of the U.S. Nuclear Regulatory Commission (NRC) (Reference 3), that technetium removal was neither required (it is low-level waste and not highly radioactive), nor economically practical. Even though the analysis and DOE's agreement with the NRC indicated technetium removal was not required, a technetium removal system was included in the WTP conceptual and preliminary design, and included in the Part B permit application. Work performed during the ongoing design process has again confirmed that technetium removal is not a practical, cost-effective process. The proposed modification deletes the related process equipment, tanks, and ancillary equipment.

In accordance with the dangerous waste regulations, a notice on the proposed modification will be sent to the facility mailing list and published in the local newspaper. In addition, a public meeting will be held on the proposed Class 2 permit modification.

Please note that the two figures in the attached revised Part A Form 3 permit application are designated "Official Use Only," Pages 51-1-16 and 51-1-17, and require protection due to national security concerns.

If you have any questions, please contact me, or your staff may contact Lori A. Huffman, Environmental Division, (509) 376-0104.

Sincerely,

Roy J. Schepens
Manager

for

ED:LAH

Attachment

cc w/attach:
B. G. Erlandson, BNI
J. P. Henschel, BNI
J. Markillie, BNI
J. Cox, CTUIR
S. L. Dahl, Ecology
R. Skinnarland, Ecology
S. J. Skurla, Ecology
S. A. Thompson, FHI
P. Sobotta, NPT
J. B. Hebdon, RL (w/o attach)
A. C. McKarns, RL
R. Jim, YN
Administrative Record
Environmental Portal, LMSI

Attachment
04-ED-024

Class 2 Permit Modification Request for the
Waste Treatment and Immobilization Plant

Hanford Facility RCRA Permit Modification Notification Form
Part III, Chapter 10 and Attachment 51
Waste Treatment and Immobilization Plant

March 2004

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Waste Treatment and Immobilization Plant	Part III, Chapter 10 and Attachment 51	

Description of Modification: This modification supports the requirement to resubmit information associated with the 10-year renewal of the Dangerous Waste Portion of the Hanford Facility RCRA Permit. Additionally, this modification updates elements of Attachment 51 to incorporate compliance schedule packages that have been submitted to Ecology, presents the new Hanford Tank Waste Treatment and Immobilization Plant (WTP) configuration of two high-level waste melters and two low activity waste melters, and eliminates the technetium ion exchange system from the pretreatment facility.

Please see Attachment 1 for additional information.

Attachment 51, Chapter:

1. Part A Form 3, located in Chapter 1
2. Topographic Map, located in Chapter 2
3. Process Information, located in Chapter 4 and Appendix 4A
4. Inspection Schedules, located in Appendix 6A
5. List of Critical Systems, located in Appendix 2.0

Redline/strikeout of modification

Please see Attachment 2.

Replacement sections

Please see Attachment 3

Modification Class: [1,2,3]	Class 1	Class [1]1	Class 2	Class 3
Please check one of the Classes:	☐	☐	☒	☐

Relevant WAC 173-303-830, Appendix I Modification: G.1.b and L.2 pursuant to WAC 173-303-680

G.1.b: Modification or addition of tank units resulting in up to 20% increase in the facility's tank capacity.

L.2: Changes to increase by up to 25% of a feedstream feed limit, pursuant to WAC 173-303-680

Submitted by Co-Operator:		Reviewed by ORP:		Reviewed by Ecology:		Reviewed by Ecology:	
[signature]	3/25/04	[signature]	3/25/04				
J.P. Henschel	Date	R. Schepens	Date	S. Dahl	Date	G. Davis	Date

[1] Class 1 modifications requiring prior Agency approval.
[2] This is only an advanced notification of an intended Class [1]1, 2, or 3 modification, this should be followed with a formal modification request, and consequently implement the required Public Involvement processes when required.
[3] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to [1]1, if appropriate.

Attachment 1
Description of Modification

Description of Modification

In September 2002, the Dangerous Waste Permit (DWP) was issued by the Washington State Department of Ecology (Ecology) to Bechtel National, Inc. (BNI), the US Department of Energy, Office of River Protection (DOE-ORP), and the DOE Richland Operations Office (DOE-RL). The permit regulates dangerous waste management processes at the Hanford Tank Waste Treatment and Immobilization Plant (WTP). This includes tank systems, miscellaneous treatment systems, containment buildings, and container storage areas.

This modification is being submitted primarily in response to the requirement to resubmit information associated with the 10-year permit renewal of the Dangerous Waste Portion of the Hanford Facility RCRA Permit. Additionally, this modification:

- Updates elements of Attachment 51 to incorporate compliance schedule packages
- Presents the new WTP configuration of two high-level waste (HLW) melters and two low activity waste (LAW) melters
- Eliminates the technetium ion exchange system from the pretreatment (PT) facility.

These changes are technical in nature and do not affect the mission of the WTP to pretreat and immobilize mixed waste from DOE's double shell tank system. The changes presented in this modification are of three categories. They are:

1. Aligning Attachment 51 with compliance schedule packages required by the Permit.
   - Alignment of Attachment 51 Chapters 1, 2, 4 and Appendices 4A and 6A with compliance schedule packages that Ecology incorporated into the Permit on March 31, 2003, July 25, 2003, September 9, 2003, and December 18, 2003.

2. Plant reconfiguration
   - Reconfiguration of the melter systems to two HLW melters and two LAW melters
   - Elimination of the technetium ion exchange system from the PT facility

3. Updates required by the Hanford RCRA Facility Permit resubmittal
   - Changes to the WTP associated with the normal design and optimization process that have not yet been addressed in a compliance schedule package, but are required to be updated to comply with the 10-year permit renewal.

The following sections provide an overview of the permitting process established by Ecology for the WTP, and address each of the three types of changes included in this modification.

1 Overview of WTP Dangerous Waste Permitting Process

Permitting of the WTP dangerous waste management unit uses a phased (or stepped) approach. The first phase was completed on September 25, 2002, with Ecology's issuance of a final permit for beginning construction of the LAW and HLW vitrification facilities and a compliance schedule to provide additional detailed information to Ecology. The compliance schedule addresses submittal of information necessary for construction of the rest of the WTP, and eventual operation. The second phase of permitting is implementation of the compliance schedule, which requires design and other information be submitted before regulated portions of the WTP are constructed. The third phase of permitting is implementation of the last portion of the compliance schedule, which requires updating sections of Attachment 51. These sections of the Permit are administrative in nature, and cannot be completed before the design is nearly complete (e.g., Contingency Plan, Closure Plan, Training Plan). It is anticipated that at the completion of these three phases, the WTP will be in compliance with all the relevant requirements of Chapter 173-303 Washington Administrative Code, and after receiving written permission from Ecology, can begin storage or treatment of dangerous and/or mixed waste. For more details on the WTP permitting process, see the September 25, 2002, Fact Sheet (Ecology Publication Number 01-05-006).

The engineering submittals (or packages) have been structured to allow the Permittees to provide design information in roughly the same order as the buildings are constructed. Therefore, the packages start at the lowest level of the building (i.e., below grade levels) and are submitted for regulated areas of each level of the building before construction begins. This process has been modified for some packages. If the process system in the package is located on more than one level in a WTP Building, the permit package can address components on more than one building level. This will prevent the confusion caused by one process system description being segmented into multiple permit packages.
The Permit breaks out packages into three general groups by the type of regulated equipment:

- Secondary containment (e.g., cell liners)
- Primary containment (e.g., tanks, miscellaneous units [i.e., evaporators and melters], containment buildings)
- Other associated, regulated equipment (e.g., ancillary equipment, equipment associated with miscellaneous units)

Using tank systems as an example, secondary containment packages include details of the design of secondary containment that must be in place in regulated areas when the floors and walls are built for that level of the building (e.g., floor slope, sump location). Construction of the floors and walls is usually followed by the installation of tanks and other large equipment. Therefore, a tank package on that level will be included in the Permit before installation (e.g., structural details for those tanks or miscellaneous units showing nozzle locations, unit volumes, materials of construction, and tank shell thickness). The last equipment usually installed on a level for a tank system is the ancillary equipment (e.g., piping, pumps, process instrumentation, electrical equipment). Therefore, the ancillary equipment package that provides details for equipment on that level will be included in the Permit before installation (e.g., materials of construction, pipe support details, pump types and their operating limits).

Thirty-five of the approximately 150 packages scheduled have been prepared, made available for review by the public, and have been incorporated by Ecology into the Permit. The remaining engineering packages will be submitted to Ecology for review and inclusion in the Permit over the next several years.

2 Aligning Attachment 51 with Compliance Schedule Packages

Since the Permit was issued in September 2002, thirty-five compliance schedule packages have been prepared by the Permittees and submitted to Ecology, made available to the public for review, and have been incorporated into the Permit by Ecology. These packages addressed secondary containment systems, tank systems, containment buildings, and container storage throughout the WTP. Information submitted in these packages consists of assessment reports prepared by an independent, qualified, registered professional engineer; general arrangement drawings; process flow diagrams; piping and instrumentation diagrams; assembly drawings; specifications; data sheets; and descriptive documentation. Following public review, Ecology incorporated the components of these permit packages into Appendices located in Attachment 51 and reissued the permit on March 31, 2003, July 25, 2003, September 9, 2003, and December 18, 2003.

Consistent with the requirement to submit information for the Hanford RCRA Facility Permit resubmittal, this modification aligns the text portions of Attachment 51 Chapters 1, 2, 4 and Appendices 4A and 6A with these approved packages. Otherwise, this realignment would have occurred prior to the initial receipt of dangerous waste, consistent with Permit Condition III.10.E.9.e.vi. Examples of changes made to the text portions of Attachment 51 as a result of these approved permit packages include:

- Updating plant item names, identification numbers, and sizes
- Replacing process figures from Appendix 4A with the following engineering drawings: process flow diagrams and piping and instrumentation diagrams
- Replacing general arrangement figures with general arrangement engineering drawings
- Referring the reader in Chapter 4 to documents that reside elsewhere in the permit to obtain additional information
- Referencing permit tables contained in the WTP Unit portion of the Hanford RCRA Facility Permit.

3 Plant Reconfiguration

This modification addresses reconfigurations affecting PTF, the LAW vitrification facility, and the HLW vitrification facility. The first reconfiguration eliminates the technetium removal system. The second revised the WTP configuration to 2 LAW and 2 HLW melters. These are described below.

3.1 Elimination of Technetium Removal System

This modification proposes to eliminate the technetium removal system located in the PTF. Narrative description and figures in Attachment 51 Chapter 4 and Appendix 6A have been updated to incorporate this change.

The decision to terminate efforts to incorporate a technetium removal system in the WTP is consistent with DOE's 1996 technical analysis[1] regarding tank waste pretreatment. That analysis indicated, to the satisfaction of the U.S. Nuclear Regulatory Commission[2] (NRC), technetium removal was neither required (it is low level waste and not highly radioactive), nor economically practical. Even though the analysis and DOE's agreement with the NRC indicated technetium removal was not required, a technetium removal system was included in the WTP conceptual and preliminary design. The work done during design again confirmed that technetium removal is not a practical, cost-effective process. In summary:

- The ability to remove technetium from Hanford tank wastes has not improved. It would be a costly and speculative process
- The amount of technetium that would be in the LAW is less than previously thought -- approximately 25,500 curies (0.02% of the total tank radionuclide inventory)
- With a robust waste form, technetium projected dose levels, even thousands of years in the future, are a small fraction of regulatory standards.

[1] Technical Basis for Classification of Low-Activity Waste from Hanford Site Tanks, WHC-SD-WM-TI-699, Rev. 2, dated September 1996.

[2] Letter from Carl J. Paperiello, Director, Office of Nuclear Material Safety and Safeguards, NRC, Washington, D.C., to Jackson Kinzer, Assistant Manager, Office of Tank Waste Remediation System, DOE-RL, "Classification of Hanford Low-Activity Waste Fraction," dated June 9, 1997.

The plant items removed from the Permit as a result of this proposed modification are identified below:

Table 1 Technetium Removal Process Plant Items Deleted from PT Facility

Plant Item Name from the Permit	Plant Item Number from the Permit
Technetium Ion Exchange Column	C13001
Technetium Ion Exchange Column	C13002
Technetium Ion Exchange Column	C13003
Technetium Ion Exchange Column	C13004
Caustic Rinse Collection Vessel	V13008
Treated LAW Buffer Vessel	V43110A
Treated LAW Buffer Vessel	V43110B
Treated LAW Buffer Vessel	V43110C
Technetium Eluant Recovery Evaporator	V43069
Recovered Technetium Eluant Vessel	V43071
Process Condensate Hold Vessel	V41013
Technetium Concentrate Lute Pot	V43072
Associated Ancillary Equipment	

3.2 Melter Configuration

This modification proposes to change the configuration of the WTP from 3 LAW melters and 1 HLW melter to 2 LAW melters and 2 HLW melters. Narrative description and figures in Attachment 51 Chapter 4 and Appendix 6A have been updated to incorporate this change.

The Hanford Federal Facility Agreement and Compliance Order (HFFACO or Tri-Party Agreement) milestone for completion of waste processing is 2028. An analysis of options was performed to maximize the opportunity for using the WTP to complete this waste cleanup mission at Hanford. It was determined that the first step relative to accelerating the Hanford waste processing to meet the Tri-Party Agreement milestone of 2028 is that installed capacity must be constructed that can achieve high initial throughputs of HLW. The results of significant research and technology, flowsheet analysis, process modeling, and design evolution were used in the analysis. Based on this effort, the WTP configuration of 2 HLW and 2 LAW melters meets the initial performance requirements of the WTP and maximizes the opportunity for using the initial WTP to complete Hanford's tank waste clean-up mission.

The plant items added to the design as a result of this proposed modification are identified below:

Table 2 Plant Items Added to HLW Vitrification Facility as a Result of New Melter Configuration

Plant Item Name	Plant Item Number
SBS Condensate Receiver Vessel	HOP-VSL-00903
Canister Decon Vessel 2	HDH-VSL-00004
Melter 2 Feed Preparation Vessel	HFP-VSL-00005
Melter 2 HLW Melter Feed Vessel	HFP-VSL-00006
Decontamination Tank Melter Cave 2	HSH-TK-00002
Melter 2	HMP-MLTR-00002
Melter 2 Wet Electrostatic Precipitator	HOP-WESP-00002
Melter 2 Submerged Bed Scrubber	HOP-SCB-00002
Melter 2 High Efficiency Mist Eliminator (HEME)	HOP-HEME-00002A
Melter 2 High Efficiency Mist Eliminator (HEME)	HOP-HEME-00002B

Table 2 Plant Items Added to HLW Vitrification Facility as a Result of New Melter Configuration

Plant Item Name	Plant Item Number
Activated Carbon Adsorber	HOP-ADBR-00002
Silver Mordenite Column	HOP-ABS-00003
Thermal Catalytic Oxidizer	HOP-SCO-00004
NOx Selective Catalytic Reducer	HOP-SCR-00002
Associated Ancillary Equipment	

The plant items removed from the Permit as a result of this proposed modification are identified below:

Table 3 Plant Items Removed from the LAW Vitrification Facility as a Result of New Melter Configuration

Plant Item Name from the Permit	Plant Item Number from the Permit
Melter 3 Concentrate Receipt Vessel 3	V21003
Melter 3 Feed Preparation Vessel	V21301
Melter 3 Feed Vessel	V21302
Melter 3 SBS Condensate Vessel	V22301
Melter 3 Submerged Bed Scrubber	C22301
Melter 3 Wet Electrostatic Precipitator	G22301
LAW Melter 3	D22301
Associated Ancillary Equipment	

4 Updates Required by the Hanford RCRA Facility Permit Resubmittal

As part of the third phase of permitting described in Section 1 above, Attachment 51, Chapter 4 is required to be updated prior to initial receipt of dangerous waste (permit condition III.10.E.9.e.vi). The purpose of this update was to cause Chapter 4 to be consistent with the compliance schedule packages that had been submitted and approved by Ecology.

Chapter 4 is being revised now, however, in support of the Hanford RCRA Facility Permit resubmittal. Narrative descriptions, tables, and figures associated with regulated systems of the WTP that have not yet been the subject of compliance schedule packages have been updated. These updates result from the normal design process, and consist of:

- Updated plant item names, identification numbers, and sizes
- Updated process flow figures and associated narrative descriptions to bring the Permit description of the WTP into alignment with current design
- Removal of the immobilized LAW vitrification facility container storage area
- Removal of the central waste storage area
- Inclusion of additional containment buildings in the LAW vitrification facility
- Inclusion of additional containment buildings in the HLW vitrification facility
- Modifications to the HLW and LAW vitrification facility offgas treatment trains

These updates to the WTP will be the subject of future compliance schedule packages, as necessary, where additional details required by the Permit will be submitted to Ecology for review and approval, as required. These updates are briefly discussed in the paragraphs below.

4.1 Updates to Plant Items

At the time the Permit was originally issued, WTP tanks and miscellaneous units were identified using the BNFL, Inc. numbering system. Plant item names and identification numbers have been updated in this proposed modification to match the BNI equipment numbering system. This will align the plant item names and identification numbers presented in the Permit text with the drawings and documents that have been approved by Ecology and incorporated in the Permit appendices. In addition, the sizes of certain plant items have changed, and other plant items have been deleted as the WTP design has evolved since the Permit was first issued.

Tanks and miscellaneous units with updated sizes are identified below:

Table 4 Tanks and Miscellaneous Treatment Units Size Change

Plant	Process System	Plant Item Name	Plant Item Number	Total Volume	
				From US Gallons	To US Gallons
PTF	Plant Wash and Disposal (PWD)	Ultimate Overflow Vessel	PWD-VSL-00033	23,000	41,650
PTF	Plant Wash and Disposal (PWD)	HLW Effluent Transfer Vessel	PWD-VSL-00043	23,000	41,650
PTF	Plant Wash and Disposal (PWD)	C3 Floor Drain Collection Vessel	PWD-VSL-00046	450	4,982
PTF	Rad. Liquid Waste Disposal (RLD)	Alkaline Effluent Vessels	RLD-VSL-00017A RLD-VSL-00017B	42,950	34,340
LAW	LAW Concentrate Receipt (LCP)	Melter 1 Concentrate Receipt Vessel	LCP-VSL-00001	14,392	18,130
LAW	LAW Concentrate Receipt (LCP)	Melter 2 Concentrate Receipt Vessel	LCP-VSL-00002	14,392	18,130
LAW	LAW Melter Feed (LFP)	Melter 1 Feed Preparation Vessel	LFP-VSL-00001	6,221	9,123
LAW	LAW Melter Feed (LFP)	Melter 2 Feed Vessel	LFP-VSL-00002	6,221	9,123
LAW	LAW Melter Feed (LFP)	Melter 1 Feed Preparation Vessel	LFP-VSL-00003	6,221	9,123
LAW	LAW Melter Feed (LFP)	Melter 2 Feed Vessel	LFP-VSL-00004	6,221	9,123
LAW	LAW Primary Offgas (LOP)	Melter 1 SBS Condensate Vessel	LOP-VSL-00001	6,833	9,056
LAW	LAW Primary Offgas (LOP)	Melter 2 SBS Condensate Vessel	LOP-VSL-00002	6,833	9,056
LAW	Rad. Liquid Waste Disposal (RLD)	Plant Wash Vessel	RLD-VSL-00003	25,130	25,780
LAW	Rad. Liquid Waste Disposal (RLD)	C3/C5 Drains/Sump Collection Vessel	RLD-VSL-00004	7,218	7,696
LAW	Rad. Liquid Waste Disposal (RLD)	SBS Condensate Collection Vessel	RLD-VSL-00005	24,704	25,780
HLW	HLW Concentrate Receipt (HCP)	Concentrate Receipt Vessel No. 1	HCP-VSL-00001	17,900	20,229
HLW	Melter Offgas Treatment (HOP)	SBS Condensate Receiver Vessel No. 1	HOP-VSL-00903	10,000	9,891
HLW	HLW Canister Decontamination Handling (HDH)	Canister Bogie Decon Vessel	HDH-VSL-00001	2,500	3,314

Table 4 Tanks and Miscellaneous Treatment Units Size Change

Plant	Process System	Plant Item Name	Plant Item Number	Total Volume	
				From US Gallons	To US Gallons
HLW	HLW Canister Decontamination Handling (HDH)	Waste Neutralization Vessel	HDH-VSL-00003	5,300	5,274
HLW	HLW Canister Decontamination Handling (HDH)	Melter 1 Canister Decon Vessel	HDH-VSL-00002	580	642
HLW	Rad. Liquid Waste Disposal (RLD)	Acidic Wash Vessel	RLD-VSL-00007	16,700	18,145
HLW	Rad. Liquid Waste Disposal (RLD)	Plant Wash and Drains Vessel	RLD-VSL-00008	13,200	13,774
HLW	Rad. Liquid Waste Disposal (RLD)	Offgas Drains Collection Vessel	RLD-VSL-00002	280	366
HLW	HLW Melter Feed (HFP)	Feed Preparation Vessel	HFP-VSL-00001	8,800	8,445
HLW	HLW Melter Feed (HFP)	HLW Melter Feed Vessel	HFP-VSL-00002	8,800	8,445
LAB	Rad. Liquid Waste Disposal (RLD)	Lab. Area Sink Drain Collection Vessel	RLD-VSL-00164	3,180	3,200

Tanks and miscellaneous units removed from the design as a result of this proposed modification are identified below:

Table 5 Tanks and Miscellaneous Treatment Units Removed as a Result of Design Evolution

Plant	Process System	Plant Item Name	Plant Item Number
PTF	Waste Feed Evaporation (FEP)	Waste Feed Evaporator Separator Vessel	FEP-SEP-00001A
PTF	Waste Feed Evaporation (FEP)	Waste Feed Evaporator Separator Vessel	FEP-SEP-00001B
PTF	Waste Feed Evaporation (FEP)	Demister	FEP-DMST-00001A
PTF	Waste Feed Evaporation (FEP)	Demister	FEP-DMST-00001B
PTF	Treated LAW Evaporation (TLP)	Treated LAW Evaporator Separator Vessel	TLP-SEP-00001
PTF	Treated LAW Evaporation (TLP)	Demister	TLP-DMST-00001
PTF	Associated Ancillary Equipment	N/A	

* Plant Items listed on other tables are not included on Table 5

4.2 Updated Process Flow Figures and Narrative Descriptions

As the design has matured, waste treatment systems have been optimized. Affected process flow figures and narrative descriptions have been updated to reflect this optimization. The narrative descriptions have also been updated to align with the drawings and documents that have been approved by Ecology and incorporated in the Permit appendices.

4.3 Removal of the ILAW Container Storage Area

At the time the Permit was originally issued, the LAW vitrification facility included a storage area for immobilized low-activity waste (ILAW) containers prior to transportation off the WTP. Since then, the operations philosophy regarding the ILAW containers has changed to reflect "just-in-time" transportation approach. The ILAW containers will be transported more frequently from the LAW vitrification facility, thus eliminating the need for the storage area.

4.4 Elimination of the Central Waste Storage Area

The original WTP design included a permitted central waste storage area located within the balance of facilities (BOF). Secondary wastes were to be packaged and stored in the central waste storage area prior to being transported to an approved TSD. Since then, the operations philosophy regarding secondary wastes has been changed. Secondary wastes will be packaged and stored in approved storage within the PT facility, HLW vitrification facility, LAW facility, and analytical laboratory. Instead of moving wastes from these facilities to a permitted central location prior to transportation to an approved TSD, secondary wastes will be transported directly from the WTP waste management facilities, or managed from a centralized waste accumulation area (i.e., less than 90-day area).

4.5 Addition of Containment Buildings to the LAW Vitrification Facility

Three containment buildings are added to the LAW vitrification facility as a result of this proposed modification: the ILAW canister buffer storage area (L-B025C/D), the Consumable Import/Export Containment Building (L-0119B), and LAW Pour Cave Containment Building (L-B009B, L-B011B, L-B011C, L-B013B, L-B013C, L-B015A). These containment buildings have been part of the design of the LAW vitrification facility, but are now being identified as areas managing mixed waste.

The ILAW canister buffer storage area (L-B025C/D) was originally designated as a container storage area. Since then, the operations philosophy has changed for this area to allow re-work of ILAW containers and to provide for buffer storage for unlidded ILAW containers.

The consumable import/export containment building (L-0119B) will be located in the west end of the LAW vitrification plant on the 3 ft elevation. Typical waste management activities performed in this containment building include decontamination, size reduction, and packaging of spent equipment. Simple decontamination of components will be performed to allow contact handling. Waste streams generated within the workshop will be volume reduced as necessary by means of disassembly or other suitable means to fit standard packaging such as drums and/or small boxes.

The LAW pour cave containment building (rooms L-B009B, L-B011B, L-B011C, L-B013B, L-B013C, L-B015A) will be located in the LAW vitrification plant, elevation -21 ft. It will be used for managing ILAW containers as they are filled with glass from the LAW melters (LAW-MLTR-00001/2). The filled ILAW containers will be allowed to cool with the lids off the container.

4.6 Inclusion of Additional Containment Buildings in the HLW Vitrification Facility

Two containment buildings are added to the HLW vitrification facility as a result of this proposed modification: the HLW Drum Swabbing and Monitoring Area Containment Building (H-0126A, H-0126B, and H-B028), and Waste Handling Area (H-410B, and H-411). These containment buildings have been part of the design of the HLW vitrification facility, but are now being identified as areas managing mixed waste.

The HLW Drum Swabbing and Monitoring Area Containment Building (H-0126A, H-0126B, and H-B028) was originally a container storage area. Since then, the operations philosophy was revised. Typical waste management activities performed in this containment building include staging and remote handling of 55 US gallon drums containing spent consumables. Handling activities include swabbing the drums for surface contamination and decontaminated if needed.

The waste handling area consists of rooms H-410B, and H-411 on the 58 ft elevation of the HLW vitrification plant. Typical waste management activities performed in this containment building include waste sorting, segregation, and providing temporary storage of mixed waste containers (such as spent silver mordenite). The waste handling room will contain floor space for segregated storage of empty and full containers, typically 55 gallon waste drums. Tools and equipment will also be stored in this containment building.

4.7 Modifications to the HLW and LAW Vitrification Facility Offgas Treatment Trains

Three proposed changes to the offgas trains in the HLW and the LAW vitrification facilities are included in this proposed modification. These changes add activated carbon absorbers to the offgas trains of the LAW and the HLW vitrification facilities.

The Activated Carbon Adsorbers (LVP-ADBR-00001/2) miscellaneous treatment sub-system removes volatile mercury, iodine, and acid gases from the offgas of the LAW vitrification facility. The offgas flows through two adsorbers normally operated in series. When gaseous mercury is detected breaking through the leading adsorber, indicating that the carbon is loaded, the offgas flow is manually changed to make the trailing adsorber the leading adsorber. Only one adsorber is used while the loaded activated carbon is removed and replaced.

The Activated Carbon Column (HOP-ADBR-00001A/1B/2A/2B) miscellaneous treatment sub-system removes volatile mercury from the offgas of the HLW vitrification facility. The offgas normally flows through both beds in series. When gaseous mercury is detected breaking through the leading bed, the offgas flow is manually changed to make the trailing bed the leading bed, and only one column is used while the exhausted bed is removed and replaced. The flow is then changed to make the fresh bed the trailing bed.

Attachment 2
Redline/strikeout of Modification

1. Part A Form 3, located in Chapter 1
2. Process Information, located in Chapter 4 and Appendix 4A
3. Inspection Schedules, located in Appendix 6A
4. List of Critical Systems, located in Appendix 2.0

Chapter 1.0

Part A Permit Application, Revision ~~1~~2 (~~December 6, 2001~~February 2004)

CHAPTER 1.0
PART A PERMIT APPLICATION, REVISION ~~1~~ 2 (February 2004~~DECEMBER 6, 2001~~)

Contents

1.0 INTRODUCTION

PART A

The Part A, Dangerous Waste Permit ~~Application~~ (DWPA) Form 1, for the ~~River Protection Project~~ Hanford Tank Waste Treatment and Immobilization Plant (WTP) is included in the following pages. The form includes a figure showing the location of the WTP on the Hanford Site.

The Part A, ~~DWPA~~ Form 3, for the WTP is included immediately after Form 1.

- In December 2001, the original Hanford Facility Dangerous Waste Permit Part A Permit Application (Part A) Form 1, Revision 1, and Form 3, Revision 1, were submitted to the Washington Department of Ecology

- The February 2004 Part A Form 3, Revision 2 updates Section IV, Description of Dangerous Wastes; Section V, Facility Drawing; and Section VI, Photograph.

Revision 2

FORM 3 — **Dangerous Waste Permit Application**

1. EPA/State I.D. No.: W A 7 8 9 0 0 0 8 9 6 7

FOR OFFICIAL USE ONLY

Application Approved	Date Received (month/day/year)	Comments

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below (mark one box only) to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA/STATE I.D. Number, or if this is a revised application, enter your facility's EPA/STATE I.D. Number in Section 1 below.

A. First Application (place an "X" below and provide the appropriate date)

☒ 1. **Existing Facility** (see instructions for definition of "existing" facility. Complete item below.)

MO	DAY	YR
0 3	2 2	1 9 4 3

For existing facilities, provide the date (mo/day/yr) operation began or the date construction commenced. (Use the boxes to the left.)

☐ 2. **New Facility** (complete item below.)

MO	DAY	YR

For new facilities, provide the date (mo/day/yr) operation began or is expected to begin.

B. Revised Application (place an "X" below and complete Section 1 above.)

☒ **1. Facility has an Interim Status Permit**

☒ **2. Facility has a Final Permit**

III. PROCESSES - CODES AND DESIGN CAPACITIES

A. Process Code - Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process (including its design capacity) in the space provided on the (Section III-C).

B. Process Design Capacity - for each code entered in column A, enter the capacity of the process.

1. Amount - Enter the amount.
2. Unit of Measures - For each amount entered in column B (1), enter the code from the list of unit measures codes below that describes the unit of measured used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
Container (barrel, drum, etc.)	S01	Gallons or liters
Tank	S02	Gallons or liters
Waste Pile	S03	Cubic yards or cubic meters
Surface Impoundment	S04	Gallons or liters
Disposal:		
Injection Well	D80	Gallons or liters
Landfill	D81	Acre-feet (the volume that would cover one acre to a depth of one foot) or hectare-meter
Land Application	D82	Acres or hectares
Ocean Disposal	D83	Gallons per day or liters per day
Surface Impoundment	D84	Gallons or liters
Treatment:		
Tank	T01	Gallons per day or liters per day
Surface Impoundment	T02	Gallons per day or liters per day
Incinerator	T03	Tons per hour or metric tons per hour; gallons per hour or liters per hour
Other (Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Section III-C)	T04	Gallons per day or liters per day

Units of Measure	Unit of Measure Code	Units of Measure	Unit of Measure Code	Units of Measure	Unit of Measure Code
Gallons	G	Liters Per Day	V	Acre-Feet	A
Liters	L	Tons Per Hour	D	Hectare-Meter	F
Cubic Yards	Y	Metric Tons Per Hour	W	Acres	B
Cubic Meters	C	Gallons Per Day	E	Hectares	Q
Gallons Per Day	U	Liters Per Hour	H		

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III. PROCESSES -- CODES AND DESIGN CAPACITIES (continued)

Example for Completing Section III (shown in line numbers X-1 and X-2 below): A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

Line No.	A. Process Code *(from list above)*			B. Process Design Capacity 1. Amount (specify)	2. Unit of Measure *(enter code)*			For Official Use Only			
X-1	*S*	*0*	*2*	*600*		*G*					
X-2	*T*	*0*	*3*	*20*		*E*					
1	S	0	1	1,300,000		G					
2	S	0	2	5,700,000		G					
3	T	0	1	57,000		U					
4	T	0	4	Vit 16,000		U					
5	T	0	5	Containment Bldg. 19,000		U					
6	S	0	6	Containment Bldg. 170,000		U					
7											
8											
9											
10											

C. Space for Additional process codes or for describing other process (code "T04"). For each process entered here include design capacity.

Line No. 4 - T04 = Treatment in miscellaneous units by vitrification.

Line No. 5 - T05 = Treatment in miscellaneous units, in containment buildings for vitrified waste and secondary waste.

Line No. 6 - S06 = Storage in miscellaneous units, in containment buildings for secondary waste.

IV. DESCRIPTION OF DANGEROUS WASTES

A. **Dangerous Waste Number** - Enter the digit number from Chapter 173-303 WAC for each listed dangerous waste you will handle.
If you handle dangerous wastes which are not listed in Chapter 173-303 WAC, enter the four-digit number(s) that describes the characteristics and/or the toxic contaminants of those dangerous wastes.

B. **Estimated Annual Quantity** - For each listed waste entered in Column A, estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A, estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.

Revision 2

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

C. **Unit of Measure** - For each quantity entered in column B, enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
Pounds	P	Kilograms	K
Tone	T	Metric Tons	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. **PROCESSES**

1 Process Codes:
For listed dangerous waste: For each listed dangerous waste entered in column A, select the code(s) from the list of process codes contained in Section III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non-listed dangerous waste: For each characteristic or toxic contaminant entered in column A, select the code(s) from the list of process codes contained in Section III to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed dangerous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D (1); and (3) Enter in the space provided on page 4, the line number and the additional code(s).

2 Process Description: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

Note: Dangerous wastes described by more than one dangerous waste number - Dangerous wastes that can be described by more than one Waste Number shall be described on the form as follows:

1 Select one of the Dangerous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.

2 In column A of the next line, enter the other Dangerous Waste Number that can be used to describe the waste. In column D (2) on that line, enter "included with above" and make no other entries on that line.

3 Repeat step 2 for each other Dangerous Waste Number that can be used to describe the dangerous waste.

Example for completing Section IV (shown in line numbers X-1, X-2, X-3, and X-4 below) - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
X-1	*K*	*0*	*5*	*4*	*900*		*P*		*T03*	*D80*			
X-2	*D*	*0*	*0*	*2*	*400*		*P*		*T03*	*D80*			
X-3	*D*	*0*	*0*	*1*	*100*		*P*		*T03*	*D80*			
X-4	*D*	*0*	*0*	*2*					*T03*	*D80*			*included with above*

Revision 2

Photocopy this page before completing if you have more than 26 wastes to list.

ID Number (enter from page 1)

W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*	B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				D. Processes 2. Process Description *(if a code is not entered in D(1))*
1	D001	100,000	T			S02				
2	D003					S02				Included with above
3	D002					T01	S02			Included with above
4	D004					T01	S02			Included with above
5	D005					T01	S02			Included with above
6	D006					T01	S02			Included with above
7	D007					T01	S02			Included with above
8	D008					T01	S02			Included with above
9	D009					T01	S02			Included with above
10	D010					T01	S02			Included with above
11	D011					T01	S02			Included with above
12	D018					T01	S02			Included with above
13	D019					T01	S02			Included with above
14	D022					T01	S02			Included with above
15	D028					T01	S02			Included with above
16	D029					T01	S02			Included with above
17	D030					T01	S02			Included with above
18	D033					T01	S02			Included with above
19	D034					T01	S02			Included with above
20	D035					T01	S02			Included with above
21	D036					T01	S02			Included with above
22	D038					T01	S02			Included with above
23	D039					T01	S02			Included with above
24	D040					T01	S02			Included with above
25	D041					T01	S02			Included with above
26	D043					T01	S02			Included with above

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ID Number (enter from page 1)

W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*	B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				D. Processes 2. Process Description *(if a code is not entered in D(1))*
1	WT01					T01	S02			Included with above
2	WT02					T01	S02			Included with above
3	WP01					T01	S02			Included with above
4	WP02					T01	S02			Included with above
5	F001					T01	S02			Included with above
6	F002					T01	S02			Included with above
7	F003					T01	S02			Included with above
8	F004					T01	S02			Included with above
9	F005					T01	S02			Included with above
10	F039[a]					T01	S02			Included with above
11										
12										
13										
14										
15										
16										
17										
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24										
25										
26										

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ID Number (enter from page 1)

W A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*	B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
1	D002	55,000	T			T04	S01			Vitrification treatment process and storage of ILAW and IHLW
2	D004					T04	S01			Included with above
3	D005					T04	S01			Included with above
4	D006					T04	S01			Included with above
5	D007					T04	S01			Included with above
6	D008					T04	S01			Included with above
7	D009					T04	S01			Included with above
8	D010					T04	S01			Included with above
9	D011					T04	S01			Included with above
10	D018					T04	S01			Included with above
11	D019					T04	S01			Included with above
12	D022					T04	S01			Included with above
13	D028					T04	S01			Included with above
14	D029					T04	S01			Included with above
15	D030					T04	S01			Included with above
16	D033					T04	S01			Included with above
17	D034					T04	S01			Included with above
18	D035					T04	S01			Included with above
19	D036					T04	S01			Included with above
20	D038					T04	S01			Included with above
21	D039					T04	S01			Included with above
22	D040					T04	S01			Included with above
23	D041					T04	S01			Included with above
24	D043					T04	S01			Included with above
25	WT01					T04	S01			Included with above
26	WT02					T04	S01			Included with above

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Photocopy this page before completing if you have more than 26 wastes to list.

ID Number (enter from page 1)

W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

						D. Processes				
Line No.	**A. Dangerous Waste No.** *(enter code)*	**B. Estimated Annual Quantity of Waste**	**C. Unit of Measure** *(enter code)*			**1. Process Codes** *(enter)*				**2. Process Description** *(if a code is not entered in D(1))*
1	WP01					T04	S01			Included with above
2	WP02					T04	S01			Included with above
3	F001					T04	S01			Included with above
4	F002					T04	S01			Included with above
5	F003					T04	S01			Included with above
6	F004					T04	S01			Included with above
7	F005					T04	S01			Included with above
8	F039[a]					T04	S02			Included with above
9										
10										
11										
12										
13										
14										
15										
16										
17										
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ID Number (enter from page 1)

W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*	B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
1	D002	4,500	T			T05	S01	S06		Treatment and storage in containment buildings
2	D004					T05	S01	S06		Included with above
3	D005					T05	S01	S06		Included with above
4	D006					T05	S01	S06		Included with above
5	D007					T05	S01	S06		Included with above
6	D008					T05	S01	S06		Included with above
7	D009					T05	S01	S06		Included with above
8	D010					T05	S01	S06		Included with above
9	D011					T05	S01	S06		Included with above
10	D018					T05	S01	S06		Included with above
11	D019					T05	S01	S06		Included with above
12	D022					T05	S01	S06		Included with above
13	D028					T05	S01	S06		Included with above
14	D029					T05	S01	S06		Included with above
15	D030					T05	S01	S06		Included with above
16	D033					T05	S01	S06		Included with above
17	D034					T05	S01	S06		Included with above
18	D035					T05	S01	S06		Included with above
19	D036					T05	S01	S06		Included with above
20	D038					T05	S01	S06		Included with above
21	D039					T05	S01	S06		Included with above
22	D040					T05	S01	S06		Included with above
23	D041					T05	S01	S06		Included with above
24	D043					T05	S01	S06		Included with above
25	WT01					T05	S01	S06		Included with above
26	WT02					T05	S01	S06		Included with above

Revision 2

Photocopy this page before completing if you have more than 26 wastes to list.

ID Number (enter from page 1)

W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*	B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				D. Processes 2. Process Description *(if a code is not entered in D(1))*
1	WP01					T05	S01	S06		Included with above
2	WP02					T05	S01	S06		Included with above
3	F001					T05	S01	S06		Included with above
4	F002					T05	S01	S06		Included with above
5	F003					T05	S01	S06		Included with above
6	F004					T05	S01	S06		Included with above
7	F005					T05	S01	S06		Included with above
8	F039[a]					T05	S01	S06		Included with above
9										
10										
11										
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IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

E. Use this space to list additional process codes from Section D(1)

a. F039 is a multisource leachate included as a waste derived from non-specific source wastes F001 through F005.

V. FACILITY DRAWING

See facility drawing, including all existing facilities, on page 6.

VI. PHOTOGRAPHS

See facility photograph on page 7

VII. FACILITY GEOGRAPHIC LOCATION This information is provided on the attached facility drawing and photograph.

LATITUDE (degrees, minutes, & seconds)	LONGITUDE (degrees, minutes, & seconds)

VIII. FACILITY OWNER

[X] A. If the facility owner is also the facility operator as listed in Section VII on Form 1, "General Information," place an "X" in the box to the left and skip to section IX below.

B. If the facility owner is not the facility operator as listed in Section VII on Form 1, complete the following:

1. Name of Facility's Legal Owner	B. Phone Number *(area code & no.)*
See Form 1 page	

3. Street or P.O. Box	4. City or Town	5. State	6. Zip Code

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Name (print or type)	Signature	Date Signed
See attached certification		

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Name (print or type)	Signature	Date Signed
See attached certification		

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Part A Form 3 Certification

IX AND X. OWNER AND OPERATOR CERTIFICATIONS

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner/Operator R.J. Schepens, Manager U.S. Department of Energy, Office of River Protection	Date
Co-operator J. P. Henschel, Project Director Hanford Tank Waste Treatment and Immobilization Plant Bechtel National, Inc.	Date

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Chapter 4.0

Process Information

Contents

Tables

Appendices

4.0 PROCESS INFORMATION

4.1 PROCESS DESCRIPTION

Mixed waste is managed by the Hanford Tank Waste Treatment and Immobilization Plant (WTP) using tanks, containment buildings, container storage areas, and miscellaneous unit systems. The pretreatment facility uses tank systems, miscellaneous unit systems (defined in Chapter 10, Section III.10.G of this Permit), and containment buildings to prepare waste feed from the Hanford Site double-shell tank (DST) system for vitrification. The low-activity waste (LAW) vitrification facility is a miscellaneous unit system, and uses tank systems, miscellaneous unit sub-systems (defined in Chapter 10, Section III.10.H and III.10.I of this Permit), and containment buildings to vitrify LAW feed. The high-level waste (HLW) vitrification facility is a miscellaneous unit system (defined in Chapter 10, Section III.10.J and III.10.K of this Permit), and uses tank systems, miscellaneous unit sub-systems, containment buildings, and container storage areas to vitrify HLW feed. A tank system and a container storage area are used at the analytical laboratory (LAB). Container storage is used in the balance of facilities (BOF) for waste management activities. These waste management activities are discussed in the following sections.

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

4.1.1 Process Overview

The ~~Hanford Tank Waste Treatment and Immobilization Plant (~~WTP~~)~~ will store and treat waste feed from the Hanford Site double-shell tank (DST) system in the pretreatment plant. The pretreatment plant will separate the waste into two feed streams for the ~~low-activity waste (~~LAW~~)~~ and ~~high-activity level waste (~~HLW~~)~~ melters. The term *LAW feed* generally refers to the supernatant portion of the DST system waste, and *HLW feed* generally refers to the high solids content portion. Feed from the DST system is expected to be of four major waste feed types, or waste feed envelopes. These waste feed envelopes are described as follows:

- Envelope A. This waste feed envelope will contain cesium ~~and technetium~~ at concentrations high enough to warrant removal of these radionuclides during pretreatment, to ensure that the immobilized low-activity waste (ILAW) glass ~~waste~~ will meets applicable requirements.
- Envelope B. This waste feed envelope will contain higher concentrations of cesium than envelope A. ~~Both c~~Cesium ~~and technetium~~ must be removed to comply with the ILAW specifications. This envelope may also contain concentrations of chlorine, chromium, fluorine, phosphates, and sulfates that are higher than those found in envelope A, which may limit the waste incorporation rate into the glass.

- Envelope C. This waste feed envelope will contain organic compounds containing complexed strontium and transuranics (TRU) that will require removal in a processing step unique to this waste envelope. As with envelopes A and B, cesium~~ and technetium~~ will also require removal in the pretreatment process to ensure that ILAW glass ~~waste~~ meets applicable requirements.
- Envelope D. HLW feed will be in the form of a slurry containing approximately 10 to 200 grams of unwashed solids per liter. The liquid fraction of the slurry will be ~~composed of residues from~~separated from the solids and classified as envelope A, B, or C waste. ~~and t~~The solid fraction will be envelope D waste.

The WTP treatment processes are designed to immobilize the waste constituents in a glass matrix by vitrification and to treat the offgas from the processes to a level that protects human health and the environment.

Two similarly designed vitrification systems will be used in the WTP. One system will immobilize the pretreated LAW feed and the second will immobilize the pretreated HLW feed. The dangerous waste constituents in the melter feed will be destroyed, removed, or immobilized in a glass matrix through the vitrification process. The ILAW and immobilized high-level waste (IHLW) produced by the WTP will be in the form of glass packaged in steel containers for ILAW and steel canisters for IHLW~~ and placed in permitted treatment, storage, and/or disposal (TSD) facilities~~.

Secondary waste streams (e.g., ~~radioactive and~~ dangerous and mixed solid waste, nonradioactive and nondangerous liquid effluents, and ~~radioactive~~ mixed waste and dangerous liquid effluents) will be characterized and recycled into the treatment process, transported to permitted treatment, storage, and/or disposal (TSD) facilities located on the Hanford Site, or transported off-site, as appropriate. Nonradioactive dangerous waste will also be generated by laboratory and maintenance activities. This waste will be managed at the WTP until it can be transferred to an off-site TSD unit.

There are four primary components of the ~~process at the~~ WTP: pretreatment, LAW vitrification, HLW vitrification, and the analytical laboratory. In addition, each of these waste treatment processes is supported by systems and utilities known as the balance of facilities~~ (BOF)~~. The following discussion presents an overview of these waste treatment processes and ~~BOF~~ balance of facilities systems at the WTP. Figure 4A-1 presents a simplified process flow ~~figure~~ diagram of the WTP treatment processes.

Pretreatment

The waste feed will be stored and subsequently treated in the pretreatment plant prior to vitrification. The processes in the pretreatment plant will condition the waste feed and remove cesium, ~~technetium,~~ strontium, TRU compounds, and entrained solids. The waste feed will also be processed through ultrafiltration to separate the solids.

There will be ~~three~~ four types of waste management units in the pretreatment plant, as follows:

- Container storage areas
- ~~Storage and treatment t~~Tank systems
- Containment buildings
- Miscellaneous treatment systems

The structure of the pretreatment plant ~~will be~~is supported by a reinforced concrete foundation. The superstructure will be made of structural steelwork with a metal roof. Typically, the process cells within the pretreatment plant will be constructed of reinforced concrete~~ to protect plant operators from radiation. The cell floors and a portion of the cell walls will be lined with stainless steel to provide secondary containment for the process tanks and process piping~~. Secondary containment is provided as required for tank systems and miscellaneous unit systems managing dangerous or mixed waste~~. Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types is found in Section 4.2.2~~. Table 4-11 provides information on secondary containment. Figure 4A-2 and 4A-2A present simplified process flow diagrams of the pretreatment processes.

LAW Vitrification

The LAW vitrification plant will house the vitrification systems for production of the ILAW. ~~Four~~ Three types of waste management units will be located in the LAW vitrification plant, as follows:

~~Container storage areas~~

- ~~Storage and treatment t~~Tank systems
- Containment buildings
- Miscellaneous ~~units (LAW melters)~~treatment sub-systems

The LAW vitrification plant ~~building~~ will be constructed of reinforced concrete and structural steelwork. The below-grade portion of the building structure ~~will be~~is made of reinforced concrete, and the superstructure will be made of reinforced concrete and structural steelwork with a metal roof. The plant structure will be supported by a reinforced concrete mat foundation. ~~A protective coating will be applied to the concrete floor and walls of the LAW melter gallery. The floor and portions of the cell walls in process rooms that house mixed waste tanks will be lined with stainless steel. The melter pour caves will be completely lined with stainless steel~~Secondary containment is provided as required for tank systems and miscellaneous unit sub-systems managing dangerous or mixed waste~~. Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types are found in Section 4.2.2~~. Table 4-11 provides information on secondary containment. Figure 4A-3 presents a simplified process flow diagram of the LAW vitrification treatment processes.

HLW Vitrification

The HLW vitrification plant will house the vitrification systems for producing IHLW. Four types of waste management units will be located in the HLW vitrification plant, as follows:

- Container storage areas
- ~~Treatment~~ tank systems
- Containment buildings
- Miscellaneous ~~unit (HLW melter)~~treatment sub-systems

The HLW vitrification plant will be constructed of reinforced concrete and structural steelwork. The below-grade portion of the building structure ~~will be of~~is reinforced concrete construction, and the superstructure will be made of structural steelwork with a metal roof. The plant structure will be supported by a reinforced concrete mat foundation. ~~The cell and cave floors and a portion of the cell and cave walls will be lined with stainless steel to provide secondary containment for the process tanks~~Secondary containment is provided as required for tank systems and miscellaneous unit sub-systems managing dangerous or mixed waste~~. Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types are found in Section 4.2.2~~. Table 4-11 provides information on secondary containment. Figure 4A-4 presents a simplified process flow diagram of the HLW vitrification treatment processes.

Analytical Laboratory

The analytical laboratory will house the hot cells, laboratories, and systems for analyzing process samples and managing regulatory compliance samples. Two types of waste management units will be located in the analytical laboratory, as follows:

- Container storage areas
- Tank systems

The analytical laboratory will be constructed of reinforced concrete, structural steelwork, and a metal roof. The below-grade portions of the building structure will be constructed of reinforced concrete. The analytical laboratory structure will be supported by a reinforced concrete mat foundation. Secondary containment is provided as required for tank systems managing dangerous or mixed waste.~~ Table 4-11 provides information on secondary containment.~~

Balance of Facilities ~~(BOF)~~

The ~~BOF~~balance of facilities ~~will~~ includes~~, by definition,~~ support systems and utilities required for the waste treatment processes within the ~~four main process areas (~~pretreatment, LAW vitrification, HLW vitrification, and the analytical laboratory~~)~~. The ~~BOF~~balance of facilities support systems and utilities ~~will~~ include, but are not ~~be~~ limited to, heating and cooling, process steam, process water, chilled water, primary and secondary power supplies, and compressed air. The balance of facilities also includes the glass former reagent system (GFR) that supplies glass former reagents to the LAW and HLW vitrification facilities. Regulated waste management units within the balance of facilities~~BOF~~ include the ~~HLW out-of-service~~spent melter storage ~~area, the LAW out-of-service melter storage area~~facility~~,~~ and the nonradioactive dangerous waste storage area~~, and the central waste storage facility~~.

4.1.2 Pretreatment Plant

The pretreatment plant is designed to receive mixed waste from the DST system and separate and prepare the LAW and HLW feed streams for vitrification. The main functions performed at the pretreatment plant are as follows:

- Receive waste feeds from the Hanford Site DST system~~.~~
- Separate cesium, strontium, ~~technetium,~~ and TRU radionuclides from the waste feeds~~.~~
- Segregate solids into the HLW feed stream~~.~~
- Concentrate the separated radionuclides~~.~~
- Adjust the concentration of the waste for vitrification~~.~~
- Collect and monitor liquid effluents~~.~~
- Blend waste fractions to optimize treatment steps~~.~~

The purpose of this section is to describe the major systems associated with the pretreatment plant. Descriptions of process systems, ventilation systems, and mechanical support systems associated with the pretreatment plant are provided in the following sections.

~~Figure 4A-1 presents the simplified flow figure for the WTP, Figure 4A-2 presents the simplified flow of primary process systems, and t~~The following figures found in Appendix 4A and drawings, found in WA7890008967, *Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste* (DWP), ~~Appendix~~ Attachment ~~4A~~51, Appendix 8, provide additional detail for the pretreatment plant:

- Simplified flow figure for the WTP
- ~~Simplified p~~Process flow figures and drawings for process information
- Typical system figures depicting common features for each regulated system
- ~~Simplified g~~General arrangement figures and drawings showing locations of regulated equipment ~~and associated tanks~~
- Waste management area figures ~~and drawings~~ showing plant locations to be permitted

Instrumentation, alarms, controls, and interlocks will be provided for the tank systems and miscellaneous treatment systems to indicate or prevent the following conditions, as appropriate:

- Overfilling: Plant items are protected against overfilling by liquid level indication, high level instrumentation interlocks to shut off feed sources, and process control system control functions backed up by hard wired trips as required.

- Loss of containment: Plant items are protected against containment loss by liquid level indication, and by process control system control and alarm functions as required, including shut off of feed sources. Each plant item that manages liquid mixed or dangerous waste is provided with secondary containment. Sumps associated with the management of liquid mixed or dangerous waste are provided with liquid level instrumentation and an ejector or pump to empty the sump as needed.

- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or to the wrong location.

In addition to level control, temperature and pressure may be monitored for tank systems and miscellaneous treatment systems in some cases. Additional information may be found in the system logic descriptions located in DWP Attachment 51, Appendix 8.13. Regulated process and leak detection system instruments and parameters will be provided in DWP Table III.10.E.E for tank systems and in DWP Table III.10.G.C for miscellaneous treatment systems.
~~Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant~~

4.1.2.1 Waste Feed Receipt Process System (FRP)~~-System~~

Figure 4A-5 presents a simplified process flow diagram of the waste feed receipt process system (FRP). ~~The FRP receives waste from the DST system and pretreatment waste processing, facilitates sampling of the waste, provides lag storage, and transfers the waste feed for subsequent treatment within the pretreatment plant~~The primary function of the ~~waste feed receipt process system~~ (FRP) is to receive batch transfers of LAW waste feed from the DST system, and to store the waste pending processing through pretreatment. Each ~~waste feed receipt vessel~~Waste Feed Receipt Vessels (FRP-VSL-00002A/B/C/D) has a working volume of approximately 375,800 gallons, for a total working volume of approximately 1.5 million gallons. Waste feed will normally be transferred from the DST system in ~~approximately 1 million gallon~~ batches up to 1 million gallons into ~~3~~three of the ~~4~~four ~~waste feed receipt vessel~~Waste Feed Receipt Vessels (FRP-VSL-00002A/B/C/D). The fourth vessel containing waste feed from the preceding transfer is used to sustain production while the current batch transfer is being mixed and sampled to verify waste characteristics.

The~~ FRP waste feed receipt vessel~~Waste Feed Receipt Vessels (FRP-VSL-00002A/B/C/D) can also receive excess recycles or excess concentrate from the waste feed evaporat~~e~~ion process system (FEP), and off-specification treated LAW from the treated LAW concentrate storage process system (TCP). The LAW feed stored in the~~ FRP waste feed receipt vessel~~Waste Feed Receipt Vessels (FRP-VSL-00002A/B/C/D) is batch–transferred forward for processing to either the FEP system or to the ultrafiltration system (UFP). The FRP system also has the capability to return stored waste to the DST system.

The main components of the FRP tank system are:

- ~~Three w~~Waste transfer lines
- ~~Four waste feed receipt vessel~~Waste Feed Receipt Vessels (~~V11020A~~FRP-VSL-00002A~~,~~ ~~V11020/~~B~~, V11020/~~C~~, and V11020/~~D)

~~A cell containing the receipt vessels, including containment and ventilation features~~

~~Waste sampling equipment~~

~~Receipt tank mixing and transfer components~~

~~Piping associated with waste receipts and transfers~~

- Vessel inlet and outlet valve headers
- ~~Two p~~Pumps ~~for transferring waste (return pump FRP-PMP-00001 and transfer pump FRP-PMP-00002A)~~

Waste feed is received from the DST system through the inner pipe of any one of three co-axial transfer ~~pipes~~lines. ~~These pipes, equipped with leak detection systems within the outer pipe, allow receipt of the waste into the four receipt vessels. Piping is also available to allow transfer of waste from one receipt vessel to another, as well as allowing storage and return of treated waste from within the pretreatment plant~~The inlet valve header routes the waste to the ~~FRP waste feed receipt vessel~~Waste Feed Receipt Vessels (FRP-VSL-00002A/B/C/D). The inlet and outlet valve headers and pumps are used in combination to facilitate the transfer of waste from one ~~waste feed receipt vessel~~Waste Feed Receipt Vessel to another, forward transfer of waste to the pretreatment process, or the return of waste to the DST system using the transfer lines.

FRP system design features include:

- Capability to pressure-test both the inner and outer transfer lines for integrity
- Transfer line leak detection system for integrity indication during transfer

~~Transfer line flushing and draining capability~~

- Transfer line flushing and draining capability ~~Permissive interlocks to preclude inadvertent transfer from/toto or from the DST system~~

~~Instrumentation for monitoring of vessel liquid level~~

~~Control system alarms and interlocks to prevent vessel overflow~~

- Instrumentation for monitoring vessel liquid level ~~Vessel overflow to a secondary receiver vessel for assurance ofto ensure a minimum vessel vapor space (prevents overfill of a vessel)~~
- Vessel vent to the pretreatment vessel vent process system (PVP) ~~to prevent pressurization of a vessel~~
- Forced air purge and passive air purge of the vessel vapor space for mitigation of hydrogen gas buildup

- Internal pulse jet mixers (PJMs) for solids suspension and slurry mixing
- Remote sampling capability off the discharge of the transfer pump
- Vessel spray rings for vessel decontamination

The ~~waste feed receipt vessel~~Waste Feed Receipt Vessels (FRP-VSL-00002A/B/C/D) are designed for a 40-year life, and are of welded stainless steel construction. Each ~~tank~~ vessel is ~~equipped with pulsejet mixers to mix the vessel contents and suspend solids. Reverse flow diverters are provided for each vessel to transfer the waste, and each is equipped with an automated sampling system to allow confirmation of the individual tank waste characteristics. Waste receipt vessels are vented to the Pretreatment Vessel Vent Process System (PVP).~~

~~The cell containing the receipt vessels is partially lined with stainless steel to form a secondary containment. This secondary containment will accommodate up to 100 % of the volume of the largest vessel in the cell and will have a gradient (minimum 1%) designed to channel fluids to a sump. This sump is equipped with liquid level detection and alarm capabilities and an ejector to allow transfer of waste detected. Cell and vessel wash capabilities are installed for decontamination activities. The receipt vessels have internal wash rings for this purpose~~located in an inaccessible (black) cell. Each cell is partially lined with welded stainless steel for secondary containment. This secondary containment will have a gradient designed to channel liquid to a low–point sump within each black cell. Each sump is equipped with liquid level instrumentation and is alarmed for detecting loss of vessel or piping integrity. Each sump is equipped with an emptying ejector.

The FRP system pumps ~~(FRP-PMP-0001/2A)~~ and valve headers are located in a hot cell to facilitate remote replacement. The hot cell is also partially lined for secondary containment. The hot cell has ~~an~~three instrumented sumps for liquid detection.

The FRP black cells are located around the hot cell. Hydraulic connections connect the black cells~~,~~ to each other and connect selected black cells ~~and~~ to the hot cell. These hydraulic connections are used to cascade fluid flow between cells in the event that the FRP black cell secondary containment hold-up volume is exceeded. As the liquid cascades from cell to cell it will reach the hot cell.

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the FRP to indicate or prevent the following conditions:~~

- ~~Vessel contents overflow (level indication, controls, and passive overflow routes to the contingency vessels)~~
- ~~Inadvertent gas/steam flowing into the vessel or being generated causing pressurization (vessels vented to the vessel vent system, temperature indication)~~
- ~~Loss of system integrity (vessel and sump level indications)~~

~~□Loss of mixing function (air pressure/flow indication)~~

~~□Vessel overflow (transfers from DST and into vessels not permitted if level is high because it may cause overflow)~~

~~□Inadvertent transfer (WTP permissive signals to transfer pumps operated by the tank farm contractor)~~

~~□High temperature or level in the system that could compromise system integrity (instruments, alarms)~~

~~□Inaccurate tank level (density compensator to adjust waste level indicated to actual level)~~

4.1.2.2 Waste Feed Evaporation Process System (FEP)

Figure 4A-6 presents a simplified process flow diagram of the waste feed evaporation process system (FEP). The primary process function~~s~~ of the FEP tank and miscellaneous treatment system ~~are~~ is to concentrate LAW ~~receive waste~~ from the FRP ~~and miscellaneous recycle streams, to evaporate a portion of the feed (reducing the volume and increasing the sodium concentration), to transfer the waste~~dilute HLW feed from the HLW lag storage and feed blending process system (HLP), and recycle from the plant wash and disposal process system (PWD) and the spent resin collection and dewatering process system (RDP). The ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) will deliver concentrate to the ~~U~~ultrafiltration ~~P~~process ~~S~~system (UFP)~~, to condense the~~. ~~o~~Overhead vapors and ~~transfer~~ non-condensables from the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) are routed to the ~~P~~primary ~~C~~condensers (FEP-COND-00001A/B). Process condensate from the ~~P~~primary ~~C~~condensers (FEP-COND-00001A/B) and steam condensate from the vacuum system are collected in the ~~LAW feed evaporator condensate vessel~~LAW Feed Evaporator Condensate Vessel (FEP-VSL-00005) and discharged to the ~~R~~radioactive ~~L~~liquid ~~W~~waste ~~D~~disposal ~~System~~ process system (RLD)~~,~~. The non-condensables from the vacuum system ~~and~~ are discharged ~~to vent non-condensable gases~~ to the PVP ~~for treatment~~system.

~~The FEP is composed of two evaporator trains arranged in parallel. The evaporator trains can be operated independently or at the same time depending on the evaporation needs~~During off-normal conditions, excess dilute recycles to the FEP ~~waste feed evaporator feed vessel~~Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B), or excess concentrate from the FEP ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B), can be routed to the FRP system for interim storage. Washed solids from the UFP system that are collected in the HLP system that are too dilute for feed to HLW vitrification can also be concentrated.

The main components of the FEP tank and miscellaneous treatment system are~~:~~ as follows.

Tanks

- ~~Two waste feed evaporator feed vessel~~Waste Feed Evaporator Feed Vessels (~~V11001~~FEP-VSL-00017A ~~and V11001~~/B)
- LAW Feed Evaporator Condensate Vessel (FEP-VSL-00005)

- Vessel outlet valve headers

~~Two fFeed pumps (FEP-PMP-00007A/B)~~

~~□Two evaporator trains, each composed of a waste feed evaporator separator vessel (V11002A and V11002B) with demisters, a reboiler, a recirculation pump, and overhead condensers~~

~~□Single LAW feed evaporator condensate pot vessel (V11FEP-VSL-00005)~~

- ~~Condensate transfer~~ P~~p~~umps ~~and associated piping for transfer(FEP-PMP-00006A/B) of waste~~

Miscellaneous Treatment Systems

~~Two separator vessels~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B)

~~Two recirculation pumps (FEP-PMP-00009A/B)~~

~~Two reboilers (FEP-RBLR-00001A/B)~~

- ~~Two concentrate pumps (FEP-PMP-00008A/B) with outlet valve header~~
- ~~Two~~ P~~p~~rimary C~~c~~ondensers (FEP-COND-00001A/B)
- ~~Two~~ I~~i~~nter-C~~c~~ondensers (FEP-COND-00002A/B)
- ~~Two~~ A~~a~~fter-~~c~~Condensers (FEP-COND-00003A/B)
- Pumps

The FEP system includes two ~~waste feed evaporator feed vessel~~Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B) ~~are forced-circulation units operating under vacuum to reduce the operating temperature. Each evaporator feed vessel has a pulsejet agitation system to provide mixing and to prevent settling of solids. The waste feed from the feed vessels is pumped continuously to the evaporator~~with a batch volume of approximately 50,000 gallons each for managing feed makeup from multiple sources. One ~~waste feed evaporator feed vessel~~Waste Feed Evaporator Feed Vessel will be in a makeup mode while the alternate vessel is feeding the evaporator trains.

~~A pump maintains a high flow rate around the evaporation system. The pump transfers the waste through the reboiler and back into the waste feed evaporator separator vessel. The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head to increase the boiling point above the temperature of the liquor in the reboiler.~~

The design features of the FEP evaporator feed system include:

- Internal pulse jet mixers for solids suspension

~~Instrumentation for monitoring of vessel liquid level~~

~~Control system alarms and interlocks to prevent vessel overflow~~

- Instrumentation for monitoring vessel liquid level ~~Vessel overflow to the ultimate overflow vessel (PWD-VSL-00033)~~
- Vessel vent to the PVP system ~~to prevent pressurization of a vessel~~

- Forced air purge and passive air purge of the vessel vapor space for mitigation of hydrogen gas buildup
- Pump and line flushing capability
- Transfer flow rate indication and transfer volume totalizer
- Remote sampling capability off the discharge of the transfer pumps
- Vessel spray rings for vessel decontamination

The FEP waste feed evaporator trains can be operated independently or at the same time depending on the evaporation needs. The ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) are forced-circulation units operating under vacuum to reduce the operating temperature. ~~A r~~Recirculation pumps ~~(FEP-PMP-00009A/B)~~ maintains a high flow rate from the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) to the R~~r~~eboilers (FEP-RBLR-00001A/B). The pumps ~~(FEP-PMP-00008A/B)~~ transfers the waste through the ~~r~~Reboilers and back into the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B). The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head (submergence) above the ~~r~~Reboiler tubes.

As the liquid travels ~~through~~ out of the R~~r~~eboilers (FEP-RBLR-00001A/B), the hydrostatic head diminishes and flash evaporation occurs as the flow enters the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B). The liquid continues to flash and the vapor and liquid streams are separated (liquid-vapor disengagement). The liquid stream circulates in this ~~closed~~ loop and becomes more concentrated, while the vapor stream passes through a demisting section to the evaporator ~~overheads~~ condensing system. The concentrate off-take ~~comes from a~~is pumped from the bottom of the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) at the controlled liquid density and is discharged to ~~evaporator concentrate bufferultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (~~V12010~~UFP-VSL-00001A~~-and V12010~~/B) in the UFP system, or is recycled to the FRP system.

The vapor stream ~~from~~ exiting the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) is condensed in ~~the overhead system which contains~~ a three-stage condenser system consisting of ~~a p~~Primary C~~c~~ondensers (FEP-COND-00001A/B), ~~an~~ I~~i~~nter-~~condenser~~Condensers (FEP-COND-00002A/B), and ~~an a~~After-~~condenser~~Condensers (FEP-COND-00003A/B). The non-condensables ~~from~~ exiting downstream of the ~~after~~After-~~c~~Condenser ~~pass through the demister, which removes entrained droplets. The non-condensables~~ are ~~then~~ routed to the PVP system for treatment~~. The condensed vapor from the overhead system is collected in a condensate pot and then transferred to process condensate vessels in the Radioactive Liquid Waste Disposal System (RLD) for discharge to the Liquid Effluent Retention Facility (LERF) and/or the Effluent Treatment Facility (ETF). If the condensate does not meet the LERF/ETF waste acceptance criteria, the condensate from the system is recycled back through the waste feed evaporation system~~.

Design features of the evaporator trains include:

Operating pressure indication and control

-
- Differential pressure indication across the ~~w~~Waste ~~f~~Feed ~~e~~Evaporator ~~s~~Separator ~~v~~Vessels (FEP-SEP-00001A/B) demister section
- Water sprays to the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) demister section
- Process condensate radiation monitoring and recycle capability
- Low--pressure steam supply and conditioning for heating the R~~r~~eboilers (FEP-RBLR-00001A/B)
- Reboilers (FEP-RBLR-00001A/B) tube leak detection and diversion capability
- Reboilers (FEP-RBLR-00001A/B) steam condensate collection

~~Instrumentation for monitoring and control of vessel liquid level~~

- Instrumentation for monitoring and control of vessel liquid level ~~Control system alarms and interlocks to prevent vessel overflow~~
- Forced air purge of the vessel vapor space for mitigation of hydrogen gas buildup (passive venting of purge air via the downstream vessels connected to the vent header)
- Capability to drain, flush, and chemically clean the system

The condensed vapor from the FEP condensing units is collected in the ~~LAW feed evaporator condensate vessel~~LAW Feed Evaporator Condensate Vessel (FEP-VSL-00005). One condensate vessel is used to collect condensate from both evaporator trains. A small fraction of the total condensate is recycled to the ~~waste feed evaporator separator vessel~~Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) demister water sprays. The balance of the condensate is transferred to the RLD system. Off-specification condensate is recycled to the ~~waste feed evaporator feed vessel~~Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B).

Design features include:

~~Instrumentation for monitoring and control of vessel liquid level~~

~~Control system alarms and interlocks to prevent vessel overflow~~

- Instrumentation for monitoring and control of vessel liquid level ~~Vessel overflow to a contingency vessell~~
- Vessel vent to the PVP system~~ to prevent pressurization of a vessel~~
- Outlet valve header
- Remote sampling capability off the discharge of the transfer pumps
- Dip legs in the vessel that maintain a liquid seal (pressure boundary) between the vessel and the condensers
- Makeup recycle water as required for startup

The black cells and hot cell are partially lined with stainless steel for secondary containment. Black cells and hot cells~~, and are~~ will be equipped with an instrumented sump or sumps for leak detection. The sumps are equipped with a steam emptying ejector.

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters are provided in Table III.10.E.E.~~
~~Instrumentation, alarms, controls, and interlocks will be provided for the FEP to indicate or prevent the following conditions:~~

- ~~Vessel contents overflow (level indication, controls, and passive overflow routes to the contingency vessels)~~
- ~~Inadvertent gas/steam flowing into the vessel or being generated causing pressurization (vessels vented to the vessel vent system, temperature indication)~~
- ~~Loss of system integrity (vessel and sump level indications)~~
- ~~Loss of mixing function (air pressure/flow indication)~~
- ~~High temperature or high level in the system that could compromise system integrity (instruments, alarms)~~

~~Regulated pretreatment plant miscellaneous treatment system process and leak detection system instruments and parameters will be provided in Table III.10.G.C.~~

4.1.2.3 Ultrafiltration Process System (UFP)~~ System~~

Figure 4A-7 presents a simplified process flow diagram of the ultrafiltration process system (UFP). The UFP tank system separates the ~~concentrated~~ waste feed from the HLW lag storage and blending process and the waste feed receipt process systems and/or the waste feed evaporatio~~n~~r process system into a high solids stream, referred to as the HLW feed stream, and a relatively solids free stream, referred to as the LAW feed stream. In the UFP system, ~~T~~the separated solids may undergo additional treatment (washing and/or leaching operations) to reduce the quantity of IHLW produced~~. These operations will be performed in the UFP system~~. In addition, the LAW feed stream may require Sr/TRU removal (envelope C only). This operation will ~~also~~ be performed in the UFP system prior to solids separation.

The main components of the UFP tank system are:

- ~~Two evaporator concentrate bufferultrafiltration feed preparation vesselsUntrafiltration Feed Preparation Vessels (V12010UFP-VSL-00001A and V12010/B) each equipped with pulse jet mixers and cooling jackets~~
- Untrafiltration Feed Preparation Vessels UFP-VSL-00001A/B) ~~Two concentrate transfer pumps (UFP-PMP-00041A/B)~~
- ~~Two Uultrafiltration F feed Vvessels (V12011UFP-VSL-00002A and V12011/B) each equipped with pulse jet mixers and cooling jackets~~
- Ultrafiltration Feed Vessels (UFP-VSL-00002A/B)~~Two ultrafilter feed pumps (UFP-PMP-00042A/B)~~

- Two ultrafilter trains, each containing three individual U~~u~~ltrafilters ~~units~~ ~~[~~(~~G12002~~UFP-FILT-00001A/1B~~, G12003~~/2A/2B~~, G12004~~/3A/3B)~~ and (G12002B, G12003B, G12004B)]~~
- Associated ultrafilter backpulsing equipment
- ~~Three LAW~~ U~~u~~ltrafilter P~~p~~ermeate ~~hold~~ V~~v~~essels (~~V12015~~UFP-VSL-00062A~~, V12015~~/B~~, V12015~~/C)
- Pumps ~~each equipped with pulse jet mixers~~

The primary design features of the UFP system are:

- Pulse jet mixers in the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B), the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B), and in the ~~ultrafilter permeate vessels~~Ultrafilter Permeate Vessels (UFP-VSL-00062A/B/C)
- Cooling jackets on the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) and on the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B)
- Passive vessel overflow routes for the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B), the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B), and in the U~~u~~ltrafilter P~~p~~ermeate V~~v~~essels (UFP-VSL-00062A/B/C) to the ~~u~~Ultimate ~~o~~Overflow ~~v~~Vessel (PWD-VSL-00033)
- Heating ejectors for the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) and the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B)
- Emptying ejectors for the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B)
- Sampling capabilities for the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B), the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B), and in the U~~u~~ltrafilter P~~p~~ermeate V~~v~~essels (UFP-VSL-00062A/B/C)
- Vessel wash rings for the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B), the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B), and in the U~~u~~ltrafilter P~~p~~ermeate V~~v~~essels (UFP-VSL-00062A/B/C)
- Ventilation (both passive and forced) for the ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B), the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B), and in the U~~u~~ltrafilter P~~p~~ermeate V~~v~~essels (UFP-VSL-00062A/B/C)

Ultrafiltration is a filtration process in which the waste stream is processed axially through the U~~u~~ltrafilters (UFP-FILT-00001A/1B/2A/2B/3A/3B), which are long bundles of permeable tubes. Solids-free liquids pass radially through the permeable ultrafilter tubes surface while the concentration of the solids in the recirculating stream continuously increases. The resulting solids slurry may need treatment such as caustic leaching and/or water washing to reduce ~~interstitial liquid buildup to minimize~~ the quantity of IHLW glass produced.

Waste is received from the HLP, FRP, and/or the FEP systems into the ~~evaporator concentrate buffer~~~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (~~V12010~~UFP-VSL-00001A ~~and V12010~~/B) of the UFP system. The waste may be sampled here to determine the ~~U~~ultrafiltration parameters. For envelope C feeds, chemicals are added to the ~~evaporator concentrate buffer~~~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) to precipitate strontium and TRU elements contained in the incoming waste stream prior to solids concentration by ultrafiltration. Heat (if required) and agitation ~~are~~ can be applied to ensure that the precipitation process is completed.

The ~~ultrafiltration feed preparation vessels~~Untrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) feed the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B), which feed the ultrafilters themselves. During the initial solids concentration, ~~T~~the solids-free stream generated by ~~U~~ultrafiltration is designated as the LAW feed stream, which is then routed to one of the three ~~LAW~~ ~~U~~Ultrafilter ~~P~~permeate V~~hold~~ ~~v~~essels (~~V12015~~UFP-VSL-00062A~~, V12015~~/B~~, or V12015~~/C). Here, the permeate is sampled for solids breakthrough (turbidity) prior to further processing, which includes cesium ~~and technetium~~ removal and additional evaporation prior to LAW vitrification.

The resulting concentrated slurry may then be washed in the ~~ultrafiltration feed vessels~~Untrafiltration Feed Vessels (UFP-VSL-00002A/B) with process water or caustic leached to remove interstitial liquid, soluble salts, and/or HLW ~~glass~~ glass-limiting compounds and further processed through the U~~u~~ltrafilters (UFP-FILT-00001A/1B/2A/2B/3A/3B). The final concentrated ~~solids stream, or~~ HLW feed stream~~,~~ is transferred to the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (~~V12001D~~HLP-VSL-00027A ~~and V12001E~~/B) of the ~~HLW Lag Storage and Feed Blending System (~~HLP system~~)~~ and then on to the HLW vitrification process. ~~The treated solids may also be returned to the DST system via the FRP.~~ Permeate from solids treatment is also collected in Ultrafilter Permeate Vessels (UFP-VSL-00062A/B/C), but this stream is normally routed to the plant wash and disposal process system (PWD) for recycle.

During waste processing, the permeability of the U~~u~~ltrafilters (UFP-FILT-00001A/1B/2A/2B/3A/3B) is reduced over time. Re-establishing the ultrafilters' permeability can be accomplished using one of two different methods ~~which include~~: 1) backpulsing with filter permeate or 2) cleaning utilizing nitric acid or caustic. Backpulsing may be utilized while the filter is in operation, but cleaning requires the filters to be out of operation. Filter performance will be monitored to determine when cleaning is required.

~~Instrumentation, alarms, controls, and interlocks will be provided for the UFP system as follows:~~

- ~~Vessels have level instrumentation with high alarms and trip functions to minimize the chances of overflowing~~

~~□Vessels have a designated overflow route designed to handle the largest possible flow rate into the vessels~~

~~□Level instrumentation and overflow piping with alarm set points will be used to prevent the overfilling of the vessels and subsequent liquid discharge into the vessel vent system~~

~~□In case of an in-cell equipment failure, the waste will remain within the secondary containment (C5 cell) which will have an engineered route back into the process~~

~~□Leaks will be detected via sump instrumentation~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

4.1.2.4 HLW Lag Storage and Feed Blending Process System (HLP) ~~System~~

Figure 4A-8 presents a simplified process flow diagram of the HLW lag storage and feed blending process system (HLP). The ~~HLW~~ HLP system receives the envelope D slurry from the DST system and the treated HLW ~~feed streams~~slurry from the UFP system. ~~It~~ This system provides receipt, storage, and transfer capability for the envelope D feed, provides lag storage for the treated high-level waste solids slurry, and blends HLW vitrification feed prior to transfer and subsequent processing in the HLW vitrification plant. The system also provides for blending of separated cesium ~~and technetium recovered~~ from the ~~LAW treatment process into~~cesium nitric acid recovery process system (CNP) with the HLW feed stream prior to transfer to the HLW vitrification plant.

The main components of the HLP tank system are:

- ~~An HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022)
- ~~Strontium/TRU~~~~Two HLW lag storage vessels~~HLW Lag Storage Vessels (~~V12001~~HLP-VSL-00027A/~~and V12001C~~~~HLP-VSL-00027~~B)

~~□Lag storage vessels (V12001D and V12001E)~~

- ~~An HLW feed blending vessel~~HLW Feed Blending Vessel (~~V12007~~HLP-VSL-00028)

~~□Associated pumps and piping~~

The primary design features of the HLP system are:

- Pulse jet mixers in the ~~HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022), the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B), and the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (HLP-VSL-00028)
- Cooling jackets on the ~~HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022), the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B), and the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (HLP-VSL-00028)

- Passive vessel overflow routes for the ~~HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022), the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B), and the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (HLP-VSL-00028) to the ~~u~~Ultimate ~~o~~Overflow ~~v~~Vessel (PWD-VSL-00033)
- Sampling capabilities for the ~~HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022), the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B), and the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (HLP-VSL-00028)
- Vessel wash rings for the ~~HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022), the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B), and the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (HLP-VSL-00028)
- Ventilation (both passive and forced) for the ~~HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022), the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B), and the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (HLP-VSL-00028)

HLW feed from the DST system is received into the ~~HLW feed receipt vessel~~HLW Feed Receipt Vessel (HLP-VSL-00022). The waste stored in this vessel is sampled and sent to either the UFP system, the waste feed evaporation process system (FEP), or the waste feed receipt process system~~s~~ (FRP) for processing.

Treated ~~H~~high solids waste~~,~~ (~~designated as the~~ HLW feed stream) ~~stream, is~~ received from the UFP ~~and~~ system~~,~~ is stored in the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B). The waste stored in these vessels is sampled to determine blending and to comply with vitrification parameters of IHLW. In the HLP system, strontium/TRU precipitate slurry is segregated from the other HLW slurry~~,~~ and ~~stored~~ then blended in the ~~strontium/TRU~~HLW F~~f~~eed B~~b~~lending ~~lag storage~~ V~~v~~essels (HLP-VSL-00028). The HLW Lag Storage Vessels (HLP-VSL-00027B) is a back up vessel to the HLW Feed Blending Vessel (HLP-VSL-00028).

The HLW feed stream is routed from the HLW ~~l~~Lag S~~s~~torage ~~tanks~~ V~~v~~essels (HLP-VSL-00027A/B) to the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (HLP-VSL-00028). The ~~HLW feed blending vessel~~HLW Feed Blending Vessel ~~(HLP-VSL-00028)~~ also receives cesium ~~and technetium~~ that has been recovered from the LAW feed stream in the waste treatment process. The cesium ~~and technetium~~ addition rates to the HLW feed stream are controlled based upon the results of the sampling previously conducted in the ~~HLW lag storage vessels~~HLW Lag Storage Vessels (HLP-VSL-00027A/B). The final blended HLW feed stream is then transferred to the HLW vitrification plant for final treatment and immobilization. ~~.~~ Alternatively, the blended HLW feed stream may be returned to the DST system.

~~Instrumentation, alarms, controls, and interlocks will be provided for the HLP system as follows:~~

- ~~Vessels have level instrumentation with high alarms and trip functions to minimize the chances of overflowing~~
- ~~Vessels have a designated overflow route designed to handle the largest possible flow rate into the vessels~~
- ~~Level instrumentation and overflow piping with alarm/trip set points will be used to prevent the overfilling of the vessels and subsequent liquid discharge into the vessel vent system~~
- ~~In case of an in-cell equipment failure, the waste will remain within the secondary containment (C5 cell), which will have an engineered route back into the process~~
- ~~Leaks will be detected via sump instrumentation located in the cell sump~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

4.1.2.5 Cesium Ion Exchange Process System (CXP) ~~System~~

Figure 4A-9 presents a simplified process flow diagram of the cesium ion exchange process system (CXP). The primary function of the CXP tank system is to remove cesium from the LAW feed stream. This is accomplished using a series of ion exchange columns containing a resin that preferentially extracts cesium. After caustic and water rinses to remove residual LAW feed, e~~E~~lution of the cesium-loaded resin is accomplished using dilute nitric acid. The cesium-loaded nitric acid is then routed to the cesium nitric acid recovery process system (CNP) with the cesium ultimately processed in the HLW melter.

The main components of the CXP tank system are:

- ~~Four cesium ion exchange columns~~Cesium Ion Exchange Columns (~~C13001~~CXP-IXC-00001~~, C1300/2/, C13003/, and C13004~~) for cesium removal
- ~~LAW Cesium ion exchange feed vessel~~Cesium Ion Exchange Feed Vessel (~~V13001~~CXP-VSL-00001)
- Cesium ion E~~e~~xchange ~~C~~Ce~~austic R~~r~~inse C~~c~~ollection V~~v~~essel (~~V13008~~CXP-VSL-00004)
- ~~Cesium reagent vessel~~Cesium Reagent Vessel (CXP-VSL-00005)
- Cesium I~~i~~on E~~e~~xchange T~~t~~reated LAW C~~c~~ollection V~~v~~essels (CXP-VSL-00026A/B/C)
- ~~Two tPreated LAW transfer pumps (CXP-PMP-00002A/B)~~
- Pumps~~Two feed pumps (CXP-PMP-00001A/B)~~

~~Other equipment includes a~~The ~~cesium ion exchange caustic rinse collection vessel~~Cesium Ion Exchange Caustic Rinse Collection Vessel (CXP-VSL-00004) is used for receipt and transfer of the caustic rinse. Transfer of the caustic rinse is accomplished using reverse flow diverters. In addition, the ~~cesium reagent vessel~~Cesium Reagent Vessel (CXP-VSL-00005) is used to supply demineralized water and caustic solutions, as well as to supply ~~reagents (~~nitric acid~~, demineralized water, and caustic solution)~~ for elution.

The ~~cesium ion exchange feed vessel~~Cesium Ion Exchange Feed Vessel (CXP-VSL-00001) receives LAW feed from the UFP system and provides feed buffer capacity to allow continuous operation of the ion exchange system. The CXP uses four ~~cesium ion exchange columns~~Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4)~~ operating in series~~. At any given time~~,~~ ~~only~~ three of the ~~ion exchange~~ columns are ~~operating in the loading cycle,~~used in series to remove~~ing~~ cesium from the LAW feed stream~~, for purposes of column loading efficiency~~. The ~~order of the~~three columns ~~may be rotated in series so that any of the columns may be in the~~are termed lead~~ position~~, lag, and polishing columns, depending on their position in the train. The ~~remaining ion exchange~~fourth column is ~~being~~ eluted and regenerated, ~~having its spent resin replaced, or is regenerated~~ and is then placed in a standby mode~~. After a~~ until the lead column ~~is eluted, it typically becomes a lag column in the next loading cycle~~reaches the desired cesium loading. At this point, the lead column is rotated out for elution, the lag column becomes the lead, the polishing column becomes the lag, and the standby column is rotated into the polishing position.

The concentration of cesium in the feed stream is monitored prior to and following each C~~c~~esium I~~i~~on E~~e~~xchange C~~c~~olumn (CXP-IXC-00001/2/3/4). When cesium is detected above an established set point following an ion exchange column, ~~that~~ the lead column is taken out of the loading cycle, eluted, and the resin bed regenerated while the other columns are placed into the loading cycle.

Elution is part of a resin bed regeneration cycle that typically includes the following steps:

- Displacement of residual LAW feed stream in the column by rinsing with dilute caustic solution to prevent the potential of precipitating aluminum hydroxide from the LAW feed stream at low pH values. This caustic rinse is ~~collected in~~provided from the ~~cesium ion exchange caustic rinse collection vessel~~Cesium Ion Exchange Reagent Vessel (CXP-VSL-000045)~~.~~
- Displacement of residual dilute caustic solution from the column with demineralized water to prevent an acid-base reaction during elution~~.~~
- Elution of cesium ions with dilute nitric acid~~.~~
- Displacement of residual acid from the column with demineralized water to prevent an acid-base reaction with the caustic ~~rinse~~regenerant~~.~~
- Regeneration of the resin with caustic solution~~.~~

After a number of loading and regeneration cycles, the resin is expected to lose performance and is termed "spent". The number of cycles depends on LAW feed constituents, operating temperatures, properties of the resin, radiation exposure, and LAW feed throughput rates. The spent resin is slurried with recycled resin flush solution and flushed out of the column into the spent resin collection and dewatering process system (RDP) ~~system~~ for resin disposal. A slurry of fresh resin is prepared in the cesium resin addition process system (CRP) ~~system~~ and then added to the column as an ion exchange column bed replacement.

A standby elution system is provided by three tanks; one containing nitric acid, another containing demineralized water, and a third tank containing sodium hydroxide. Each tank has a volume sufficient to fully elute one fully loaded column, and one partially loaded column. The tanks are located at an elevation sufficiently high above the ~~cesium ion exchange columns~~Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4) to provide enough hydrostatic head to induce flow through the ~~reagent vessel, pumps, one of the cesium ion exchange columns~~Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4)~~,~~ and associated piping to the destination vessel.

Following cesium ion exchange, the treated LAW feed is transferred to the ~~cesium ion exchange treated LAW collection vessels~~Cesium Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C) for further treatment in the treated LAW concentrate storage process system (TCP) or the treated LAW evaporation process system (TLP).

~~Instrumentation, alarms, controls, and interlocks will be provided for the CXP system to indicate or prevent the following conditions:~~

- ~~Overfilling: Vessels are protected against overfilling by liquid level indication, and high-level instrumentation interlocks to shut off feed sources, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.~~
- ~~Overheating: Temperature regulation is provided to the ion exchange columns by a chilled water supply that operates continuously. Temperature indication is provided on each cesium ion exchange column (CXP-IXC-00001/2/3/4), and chilled water return lines will be monitored for flow to alert the operator in case of an abnormal indication. The temperature of the feed to the ion exchange columns is cooled to an acceptable level by the feed coolers located upstream of the ion exchange columns.~~
- ~~Leakage of process liquids into chilled water: Chilled water return lines will be monitored for contamination.~~
- ~~Overpressurization: Pressure relief for each cesium ion exchange column (CXP-IXC-00001/2/3/4) is provided by a relief valve that discharges to a piping header that is vented to the LAW feed vesselrupture disk.~~
- ~~Loss of containment: Vessels are protected against containment loss by liquid level indication, high-level interlocks to shut off feed sources, and process control system (PCS) control and alarm functions, as required. The cell, which drains to a sump, contains liquid leakage in this system. The cell is lined with stainless steel for secondary containment, and sump level instrumentation detects liquid leakage into the cell.~~
- ~~Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.~~
- ~~Reverse flow diverter failure: Where needed, system vessels using reverse flow diverters incorporate dual reverse flow diverter system redundancy into the design to prevent loss of process function and to maintain appropriate liquid levels in vessels if one of the reverse flow diverters should fail.~~

~~□Column hydrogen venting: Each column is provided with a separate vessel to continuously collect and vent hydrogen generated in the columns. Hydrogen is vented through a restriction orifice to the vessel vent system. Air is continually purged into the vapor space in the hydrogen venting vessel to ensure that the concentration of hydrogen is maintained in an acceptable rangeHydrogen gas which has evolved in the cesium ion exchange columns (CXP-IXC-00001/2/3/4) is purged with air into the process vessel ventilation system. An air space is maintained within each column by a level control system. To ensure that hydrogen cannot accumulate in other storage vessels, each is designed with an air purge and connected to both an overflow path and the process vessel ventilation system.~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

4.1.2.6 Cesium Nitric Acid Recovery Process System (CNP) ~~System~~

Figure 4A-10 presents a simplified process flow diagram of the cesium nitric acid recovery process system (CNP). The CNP system recovers nitric acid that was previously used for cesium ion exchange resin bed ~~regeneration~~ elution so that the nitric acid can be reused as eluant. In addition, this system concentrates and transfers to storage the cesium ~~extracted~~ eluted from the ion exchange system for incorporation into the HLW melter feeds.

The ~~main components of the~~ CNP system ~~are~~is composed of tanks and miscellaneous treatment systems, and consists of the following equipment~~:~~.

Tanks

- Eluate C~~c~~ontingency S~~s~~torage V~~v~~essel (CNP-VSL-00003)
- Cesium E~~e~~vaporator ~~r~~Recovered N~~n~~itric A~~a~~cid V~~v~~essel (CNP-VSL-00004)
- Cesium E~~e~~vaporator E~~e~~luant L~~l~~ute P~~p~~ot (CNP-VSL-00001)

Miscellaneous Treatment Systems

- Cesium E~~e~~vaporator S~~s~~eparator V~~v~~essel (CNP-EVAP-00001)
- Cesium E~~e~~vaporator C~~c~~oncentrate R~~r~~eboiler (CNP-HX-00001)
- Cesium E~~e~~vaporator N~~n~~itric A~~a~~cid R~~r~~ectifier (CNP-DISTC-00001)
- Cesium E~~e~~vaporator P~~p~~rimary C~~c~~ondenser (CNP-HX-00002)
- Cesium E~~e~~vaporator S~~s~~econdary C~~c~~ondenser (CNP-HX-00003)
- Cesium E~~e~~vaporator A~~a~~fter–C~~c~~ondenser (CNP-HX-00004)

~~High Eefficiency Pparticulate Aair Ffilter (CNP-HEPA-00006)~~

- High Efficiency Particulate Air Filter (CNP-HEPA-00006)~~Cesium evaporator recirculation~~
- Pumps~~pPumps (CNP-PMP-00001)~~

~~□The evaporator and reboiler~~

~~□A rectifier column~~

~~□Primary and after-condensers~~

~~□A pulse pot~~

~~□Cesium concentrate lute pot (V13030)~~

~~□Eluate contingency storage vessel (V13073)~~

~~□Recovered nitric acid vessel (V13028)~~

During the process of regenerating the cesium ion exchange resin beds, eluate composed of cesium-bearing nitric acid will be fed to the ~~nitric acid recovery cesium evaporator separator vessel~~Cesium Evaporator Separator Vessel (CNP-EVAP-00001) operating under reduced pressure. A closed-loop circulation stream is fed from the evaporator to the ~~steam~~ steam-heated ~~cesium evaporator concentrate reboiler~~Cesium Evaporator Concentrate Reboiler (CNP-HX-00001) and back to the ~~cesium evaporator separator vessel~~Cesium Evaporator Separator Vessel (CNP-EVAP-00001).~~ This heat input is the motive force for the evaporative process.~~

Vapors from the ~~cesium evaporator separator vessel~~Cesium Evaporator Separator Vessel (CNP-EVAP-00001), composed primarily of water and nitric acid, ~~are~~ is sent to the ~~refluxed cesium evaporator nitric acid rectifier~~Cesium Evaporator Nitric Acid Rectifier ~~column~~(CNP-DISTC-00001) where the nitric acid is recovered for reuse as eluant. Recovered nitric acid is collected in the ~~cesium evaporator recovered nitric acid vessel~~Cesium Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004) for reuse in the ~~regeneration~~ elution of cesium ion exchange column resin beds. Water vapor is recovered from the ~~system's cesium evaporator primary condenser~~Cesium Evaporator Primary Condenser (CNP-HX-00002), ~~and after-condenser routed through the waste feed evaporator~~~~cesium evaporator secondary condenser~~Cesium Evaporator Secondary Condenser (CNP-HX-00003), and ~~cesium evaporator after condenser~~Cesium Evaporator After-Condenser (CNP-HX-00004), and ~~collected in~~sent to the ~~plant wash and disposal (~~PWD~~)~~ system. These condensers are ~~water~~ water-cooled shell-and-tube heat exchangers.~~ The effluent collected from these condensers is neutralized before being recycled to the Treated LAW Evaporator Process System (TLP).~~ Uncondensed vapors exiting from the after-condenser are routed to the PVP system for further treatment.

The cesium concentrated in the evaporator is routed to the ~~HLW feed blending vessel~~HLW Feed Blending Vessel (~~V12007~~HLP-VSL-00028)~~,~~ for blending and incorporation into the HLW melter feed streams. This cesium concentrate may also be stored in the E~~e~~luate C~~e~~ontingency S~~s~~torage V~~v~~essel (CNP-VSL-00003), which is equipped with ~~cooling coils~~a cooling jacket for heat removal.

~~Because t~~The C~~e~~esium ~~nitric acid recovery~~ E~~e~~vaporator S~~s~~eparator V~~v~~essel (CNP-EVAP-00001) ~~operates under reduced pressure, the feed stream to the evaporator~~ is ~~passed~~ fed through a ~~pulse pot and enters the evaporator through the cesium concentrate lute~~ breakpot.~~ This process maintains the negative pressure on the evaporator system. The concentrated cesium stream extracted from the evaporator also passes through~~ and the C~~e~~esium E~~e~~vaporator E~~e~~luant ~~concentrate~~ L~~l~~ute P~~p~~ot (CNP-VSL-00001) in order to create a hydraulic seal to maintain a vacuum in the ~~cesium evaporator separator vessel~~Cesium Evaporator Separator Vessel (CNP-EVAP-00001).

~~Some~~ The recovered nitric acid is ~~consumed during the elution process requiring that fresh acid be added to the recovered nitric acid stream to bring the contents back to the original volume.~~periodically sampled and, ~~D~~depending on the acid concentration of the recovered acid sample, some ~~pH~~ adjustment may be necessary. Fresh 2 molar nitric acid is ~~delivered~~ available to the ~~cesium evaporator recovered nitric acid vessel~~Cesium Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004) along with process condensate to adjust the recovered acid concentration~~,~~ as ~~necessary~~required.

The CNP system only operates when a C~~c~~esium I~~i~~on E~~e~~xchange C~~c~~olumn (CXP-IXC-00001/2/3/4) is in the process of having its resin bed regenerated through an elution process. When elution of a cesium ion exchange column is not taking place, the nitric acid recovery system is maintained in a standby mode. The major vessels of the CNP system are equipped with internal wash rings for decontamination of the system.

~~Instrumentation, alarms, controls, and interlocks will be provided for the CNP system to indicate or prevent the following conditions:~~

- ~~Overfilling: Vessels are protected against overfilling by liquid level indication, high-liquid-level instrumentation interlocks to shut off feed sources, and PCS process control system control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.~~
- ~~Cooling system failure in concentrate storage vessel: Due to the heat generated in the eluate contingency storage vessel (CNP-VSL-00003) from cesium decay, two cooling coils (one operating and one spare) with a cooling water supply are provided for temperature control. If a failure should occur in the cooling water system, the process vessel vent (PVP) system is designed to remove adequate heat to delay the advent of boiling of the concentrate. A process water line is available for makeup water to the vessel to counteract evaporation of the water in the concentrate.~~
- ~~Loss of containment: Vessel containment loss is detected by liquid level indication in the cell sump, and in the event of an extremely low liquid level, PCS process control system controls and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, contains liquid leakage in this system, and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel for secondary containment.~~
- ~~Loss of cooling water to condenser: If there is a loss of normal cooling water, and backup cooling water is not available, the vacuum ejectors system and the cesium evaporator separator vessel (CNP-EVAP-0001) will automatically shut down.~~
- ~~Inadvertent transfers of fluids: System sequential transfer operations are interlocked.~~

~~Hydrogen venting: If steam flow, to the cesium evaporator concentrate reboiler (CNP-HX-00001) is lost, the purge air lines to the cesium evaporator separator vessel (CNP-EVAP-00001) are opened and hydrogen is purged from the headspace through the rectifier and condensers to the PVP system. To ensure that hydrogen cannot accumulate in~~

~~other storage vessels, each is designed with an air purge and connected to both an overflow path and the PVP system.~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

~~Regulated pretreatment plant miscellaneous treatment system process and leak detection system instruments and parameters will be provided in Table III.10.G.C.~~

4.1.2.7 Cesium Resin Addition Process System (CRP) ~~System~~

Figure 4A-11 presents a simplified process flow diagram of the cesium resin addition process system (CRP). The purpose of the CRP tank system is to provide a means to add fresh resin to the ~~cesium ion exchange columns~~Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4). The system provides for preparation of the fresh cesium resin by hydraulically removing fines from the bulk of the resin particles~~,~~ as well as chemically conditioning the fresh resin. After conditioning, the resin is transferred to the ion exchange columns as a slurry, by gravity flow~~.~~ ~~The cesium resin is chemically conditioned after transfer to a column. The CRP is located at a point over the cesium ion exchange columns which allows optimum operational efficiency.~~

The main components of the CRP tank system are:

- Cesium R~~r~~esin A~~a~~ddition V~~v~~essel (CRP-VSL-00001)
- Cesium R~~r~~esin A~~a~~ddition A~~a~~ir G~~g~~ap V~~v~~essel (CRP-VSL-00002)
- Cesium resin addition recycle pump ~~(CRP-PMP-00001)~~

Cesium is removed from the LAW feed using the ion exchange resin. Each batch of the resin has a limited useful operating life after which it must be removed from the ion exchange column and replaced with fresh resin.

Fresh resin is delivered per specification by the vendor. It is then transferred from bulk storage with the aid of handling~~/conveying~~ equipment to ~~a feed hopper mounted on the top of~~ the ~~cesium~~ resin addition ~~vessel~~room. The resin is transferred from the shipping container to the Ce~~c~~esium ~~r~~Resin A~~a~~ddition V~~v~~essel (CRP-VSL-00001) with an eductor and demineralized water. After transfer, ~~T~~the cesium resin undergoes resin conditioning processes~~ in the cesium ion exchange columns; therefore, only water is added prior to adding the cesium resin into the vessel~~. The resin is then transferred to a~~n~~ Cesium Ion Exchange Column (CXP-IXC-00001/2/3/4)~~ion exchange column~~ as a slurry by gravity flow.

There is a~~n~~ Ce~~c~~esium R~~r~~esin A~~a~~ddition A~~a~~ir G~~g~~ap V~~v~~essel (CRP-VSL-00002), located on the slurry downcomers to the ~~cesium ion exchange columns~~Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4) in the resin addition valve bulge. The function of the Cesium ~~r~~Resin A~~a~~ddition A~~a~~ir G~~g~~ap V~~v~~essel (CRP-VSL-00002) is to prevent back-flow of potentially contaminated gas, resin, or liquid, caused by a leaky or misaligned valve, from feeding back into the Ce~~c~~esium ~~resin~~ Resin ~~a~~Addition V~~v~~essel (CRP-VSL-00002). In the unlikely event of back-flow into the Cesium Resin Addition Air Gap Vessel (CRP-VSL-00002), gas is vented to the pretreatment vessel vent process system (PVP) and other constituents overflow into the Plant Wash Vessel (PWD-VSL-00044) of the plant wash and disposal process system (PWD).

The cesium resin must be conditioned before processing the LAW feed stream through the ~~cesium ion exchange columns~~Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4). The purpose of conditioning is to fully expand the resin and convert the resin into the right ionic form for cesium removal. ~~The cesium ion exchange resin is conditioned in the ion exchange column to utilize disposition of the acidic and caustic conditioning solutions through plant processes.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the CRP to indicate or prevent the following conditions:~~

- ~~High or low Ppressure in cesium resin addition vessel: Upon Hhigh or low pressure, there will be an alarm; interlock to check vessel status and readiness to receive resin and the operator will check the vessel.~~
- ~~High or low Llevel in the cesium resin addition vessel: Vessel is equipped with level controller; alarms at Upon high level, and low level;the appropriate transfer valves automatically close and the operator is alarmed. Upon low level, the agitator stops and the operator is alarmed.~~
- ~~Pressure in cesium resin addition vessel: At a set pressure level, the pressure is released into the vessel area.~~
- ~~Vacuum in cesium resin addition vessel: At a set pressure level, atmospheric air is drawn in.~~
- ~~Level in cesium resin overflow tank: At high level, flow from the screen is shut off.~~
- ~~Overflow recycle pump discharge pressure: Alarms at low discharge pressure; the operator checks on the operation of the pump. A low-low pressure will alarm.~~
- ~~High and low differential pressure across the recirculation screen: Upon high differential pressure (indicating a blinded screen), there will be an alarm and the operator will check the vessel. Upon low differential pressure (indicating a screen failure) there will be an alarm and the operator will check the vessel.~~
- ~~Recycle pump high discharge pressure: Upon high discharge pressure, the pump is automatically stopped and the operator is alarmed.~~
- ~~High and low Ddifferential pressure across the fines overflow filter: A Upon high differential pressure (indicating a plugged filter), the pump will stop, there will be an alarmed, and the operator will check or replace the filter. A Upon low differential pressure (indicatesing failure of the filter), the pump will stop, there will be an alarm, and the operator will check or replace the filter.~~
- ~~High level in air gap vessel: Upon high level, the supply valves to the air gap vessel will be closed and the operator will be alarmed.~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

4.1.2.8 ~~Technetium Ion Exchange Process (TXP) System~~ Reserved

~~The primary function of the TXP is to remove technetium from the LAW feed stream. This is accomplished using a series of ion exchange columns containing a resin that preferentially extracts technetium.~~

~~The main components of the TXP are:~~

- ~~Four technetium ion exchange columns (C43006, C43007, C43008, and C43009) for technetium removal~~
- ~~Three treated LAW buffer vessels (V43110A, V43110B, and V43110C)~~
- ~~A technetium ion exchange buffer vessel (V43001)~~
- ~~A caustic rinse collection vessel (V43056) with reverse flow diverters~~
- ~~Two technetium feed pumps and associated piping~~

~~Other equipment associated with this system includes the technetium reagent vessel for caustic solutions and process water addition and two transfer pumps for reagents and water flushes.~~

~~The TXP uses four columns operating in series. At any given time, only three of the ion exchange columns operate in the loading cycle, removing technetium from the LAW feed stream. The order of these columns may be rotated in series so that any of the columns may be in the lead position. The remaining ion exchange column is being eluted, having its spent resin replaced, or is in a standby mode. After a lead column is eluted, it typically becomes a lag column in the next loading cycle.~~

~~The concentration of technetium in the treated LAW is monitored between columns and on the inlet line to the treated LAW buffer vessels. When technetium is detected above an established set point following an ion exchange column, that column is taken out of the loading cycle and the resin bed is regenerated, while the column that was out of service is returned to the loading cycle.~~

~~Elution is part of the resin bed regeneration cycle that typically includes the following steps:~~

- ~~Displacement of residual LAW feed in the column by rinsing with dilute caustic solution to prevent the precipitation of aluminum hydroxide.~~
- ~~Rinsing of the ion exchange column with process water to prevent caustic from mixing with eluate that is transferred to the technetium eluant recovery system during the elution step.~~
- ~~Elution of sodium pertechnetate on the loaded resin with warm water from the eluant recovery system.~~
- ~~pH adjustment of the resin bed by flushing with sodium hydroxide solution to prevent precipitation of aluminum hydroxide during subsequent LAW feed processing.~~

~~The eluate from the resin bed regeneration is collected and transferred to the Technetium Eluant Recovery Process System (TEP) for recycling. The concentration of technetium in the eluate is monitored until only limited concentrations of technetium are detected in the eluate leaving the column. The process water eluate is sent to the technetium eluate receipt vessels for further processing to recover the concentrated technetium product. The water is recovered in the technetium eluant recovery system for reuse as eluant.~~

~~After a number of loading and regeneration cycles the resin is expected to lose performance and is termed "spent." The number of cycles depends on LAW feed constituents, operating temperatures, properties of the resin, radiation exposure, and LAW feed throughput rates. The spent resin is slurried with recycled resin flush solution and flushed out of the column to the Spent Resin Collection and Dewatering Process System (RDP). A slurry of fresh resin is then added to the column as a bed replacement.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the TXP to indicate or prevent the following conditions:~~

- ~~Overfilling: Vessels are protected against overfilling by liquid level indication, and high level instrumentation interlocks to shut off feed sources, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.~~
- ~~Overpressurization: Pressure relief for each ion exchange column is provided by a relief valve that discharges to a piping header that is vented in the technetium reagent vessel.~~
- ~~Loss of containment: Vessels are protected against containment loss by liquid level indication, low level interlocks to shut off feed sources and PCS control and alarm functions, as required. The cell, which drains to a sump, contains liquid leakage in this system. The cell is lined with stainless steel, and sump level instrumentation detects liquid leakage into the cell.~~
- ~~Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.~~
- ~~Reverse flow diverter failure: Where needed, system vessels using reverse flow diverters incorporate dual reverse flow diverters system redundancy into the design to prevent loss of process function and to maintain appropriate liquid levels in vessels if one of the reverse flow diverters should fail.~~
- ~~Column venting: The valves for each ion exchange column are interlocked with the column vent valve so that the vent valve closes when feed valves open to the ion exchange column. Similarly, the vent valve is closed during spent resin removal. The vent valve opens when a column is idle.~~

4.1.2.9 ~~Technetium Eluant Recovery Process (TEP) System~~ Reserved

~~The TEP recovers water from the eluate that was previously used for technetium ion exchange resin bed regeneration so that it may be reused. In addition, this system concentrates and transfers to storage the technetium extracted from the ion exchange system for incorporation into the HLW melter feed.~~

~~The main components of the TEP are:~~

- ~~Technetium eluant recovery evaporator (V43069) and reboiler~~
- ~~A rectifier column~~
- ~~Primary and after-condensers~~
- ~~A pulse pot~~
- ~~Technetium concentrate lute pot (V43072)~~
- ~~Eluate contingency storage vessel (V13073, included in the Cesium Nitric Acid Recovery Process System [CNP])~~
- ~~Recovered technetium eluant vessel (V43071)~~

~~During the process of regenerating the technetium ion-exchange resin beds, eluant composed primarily of technetium-bearing water will be fed to the technetium eluant recovery evaporator operating under reduced pressure. A closed loop circulation stream is fed from the evaporator to the steam heated reboiler and back to the evaporator. This heat input is the motive force for the evaporative process.~~

~~Vapors from the evaporator, composed primarily of water vapors, are sent to the refluxed rectifier column, where the majority of the water is recovered in the rectifier column underflow. This recovered water is collected in the recovered technetium eluant vessel for reuse in the regeneration of technetium ion-exchange column resin beds. Additional water vapors are recovered from both of the systems condensers (primary and after-condenser) and the condensate is routed to the Plant Wash and Disposal System (PWD). These condensers are water cooled shell-and-tube heat exchangers. Uncondensed vapors exiting from the after-condenser are routed to the PVP for further treatment.~~

~~The technetium concentrated from the evaporator is routed to the HLW feed blending vessel (V12007), for blending and incorporation into the HLW melter feed stream. The technetium concentrate from the evaporator can alternatively be stored in the eluate contingency storage vessel.~~

~~Because the technetium eluant recovery evaporator operates under reduced pressure, the feed stream to the evaporator is passed through a pulse pot and enters the evaporator through a lute pot. This process maintains the negative pressure on the evaporator system. The concentrated technetium stream extracted from the evaporator also passes through a lute pot.~~

~~The TEP only operates when a technetium ion exchange column is in the process of having its resin bed regenerated through an elution process. When elution of a technetium ion exchange column is not taking place, the TEP is maintained in a standby mode. The major vessels of the TEP are equipped with internal wash rings for decontamination of the system.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the CRP indicate or prevent the following conditions:~~

- ~~Overfilling: Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.~~
- ~~Loss of containment: Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS control and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system, and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.~~
- ~~Loss of cooling water to condenser: If there is a loss of normal cooling water, and backup cooling water is not available, the vacuum ejectors system and the evaporator will automatically shut down.~~
- ~~Inadvertent transfers of fluids: System sequential transfer operations are interlocked.~~

4.1.2.10 ~~Technetium Resin Addition Process System (TRP)~~Reserved

~~The purpose of the system is to provide a means to add fresh resin to the technetium ion exchange columns. The TRP provides for preparation of the technetium resin by hydraulically removing fines from the bulk of the resin particles. The system also provides for transfer to the ion exchange columns as a slurry by gravity flow. The resin is chemically conditioned in the ion exchange column. The system is located at a point over the technetium ion exchange columns which allows optimum operational efficiency.~~

~~Technetium is removed from the LAW feed stream using an ion exchange resin. Each batch of the resin has a limited useful life after which it must be removed from the ion exchange column and replaced with fresh resin.~~

~~Fresh resin is added to, prepared in, and slurried for transfer from the technetium resin addition vessel. Process water is added to make up the required slurry which is gently agitated mechanically to suspend the fine particles. Next, fines are removed from the slurry. The resin is gravity transferred as a slurry to the technetium ion exchange columns. The conditioning process involves soaking the resin in caustic. There is an air gap vessel located at the four slurry downcomers to the technetium ion exchange columns in the resin addition valve bulge. The function of each air gap vessel is to prevent back-flow of potentially contaminated gas, resin, or liquid, caused by a leaky or misaligned valve, from feeding back into the resin addition vessel.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the TRP indicate or prevent the following conditions:~~

- ~~Pressure in technetium resin addition vessel: High pressure will alarm; interlock to check vessel status and readiness to receive resin.~~
- ~~Level in technetium resin addition vessel: Vessel is equipped with level controller; alarms at high level and low level; appropriate transfer valves automatically close.~~
- ~~Pressure in technetium resin addition vessel: At a set pressure level, the pressure is released into the vessel area.~~
- ~~Vacuum in technetium resin addition vessel: At a set pressure level, atmospheric air is drawn in.~~
- ~~Level in technetium resin overflow tank: At high level, flow from the screen is shut off.~~
- ~~Overflow recycle pump discharge pressure: Alarms at low discharge pressure; the operator checks on the operation of the pump. A low-low pressure will alarm.~~
- ~~Differential pressure across the fines overflow filter: A high differential pressure indicating a plugged filter will be alarmed. A low differential pressure indicates failure of the filters.~~

4.1.2.11 Treated LAW Evaporation Process System (TLP) ~~System~~

Figure 4A-16 presents a simplified process flow diagram of the treated LAW evaporation process system (TLP). The primary functions of the TLP tank and miscellaneous treatment system ~~are as follows:~~is to concentrate treated LAW from the cesium ion exchange process system (CXP). Subsequent to sampleing and analysis, the treated LAW is pumped continuously from one of three Cesium Ion Exchange tTreated LAW Ceollection Vvessels (CXP-VSL-00026A/B/C) to the evaporator system. The Ttreated LAW Eevaporator Sseparator Vvessel (TELP-SEP-00001) will deliver treated LAW concentrate to the treated LAW concentrate storage process system (TCP) for subsequent vitrification.

- ~~Receive waste from the treated LAW collection vessels following technetium removal~~
- ~~Receive and neutralize submerged bed scrubber purge from LAW vitrification~~
- ~~Evaporate a portion of the feed (reducing the volume and increasing the sodium concentration)~~
- ~~Transfer the waste to the Treated LAW Concentrate Storage Process System (TCP)~~
- ~~Condense the overhead vapors and transfer the condensate to the Radioactive Liquid Waste Disposal System (RLD)~~
- ~~Vent non-condensable gases to the PVP for treatment~~

The TLP system also evaporates recycles from the TCP and the radioactive liquid waste disposal process system (RLD), and submerged bed scrubber recycles from LAW vitrification. Overhead vapors and non-condensables from the Ttreated LAW Eevaporator Sseparator Vvessel (TLP-SEP-00001) are routed to the Pprimary Ceondenser (TLP-COND-00001). Process condensate from the Pprimary Ceondenser (TLP-COND-0001) and steam condensate from the vacuum system are collected in the Ttreated LAW Eevaporator Ceondensate Vvessel (TLP-VSL-00002) and discharged to the RLD system. The non-condensables from the vacuum system are discharged to the pretreatment vessel vent process system (PVP).

The ~~TLP is composed of a single evaporator train and contains the following~~ main components of the TLP tank and miscellaneous treatment system are~~:~~ as follows.

Tanks

- ~~Two~~ LAW SBS C~~c~~ondensate R~~r~~eceipt V~~v~~essels (TLP-VSL-00009A/B)

~~Treated LAW Eevaporator cCondensate Vvessel (TLP-VSL-00002)~~

~~Two condensate transfer pumps (TLP-PMP-00002A/B)~~

- Treated LAW Evaporator Condensate Vessel (TLP-VSL-00002)~~Two transfer pumps (TLP-PMP-00005A/B)~~
- Vessel outlet valve header
- Pumps

Miscellaneous Treatment Systems

- Treated LAW E~~e~~vaporator S~~s~~eparator V~~v~~essel (TLP-SEP-00001)

~~Recirculation ppump (TLP-PMP-00001)~~

- Recirculation pump
- Reboiler (TLP-RBLR-00001)
- ~~Two~~ C~~c~~oncentrate p~~p~~umps ~~(TLP-PMP-00011A/B)~~ with outlet valve header
- Primary C~~c~~ondenser (TLP-COND-00001)
- Inter-~~c~~Condenser (TLP-COND-00003)

~~After cCondenser (TLP-COND-00002)~~

- After-Condenser (TLP-COND-00002)~~Demister (TLP-DMST-00001)~~

~~Two LAW submerged bed scrubber purge receipt vessels (V45009A and V45009B)~~

~~A single evaporator train composed of the LAW evaporator separator vessel (V41011) equipped with demisters, a reboiler, a recirculation pump, and overhead condensers~~

~~A single evaporator condensate pot (V41013)~~

~~Pumps and associated piping for transfer of waste~~

~~The treated LAW evaporator is a forced-circulation unit operating under a vacuum to reduce the operating temperature. The treated LAW from the TXP will be transferred to the TLP. The treated LAW buffer vessels (V43110A/B/C) will be configured in such a way that one will be filling, one will be feeding the LAW evaporator separator vessel, and one will be full, empty, or out of service. Submerged bed scrubber purge liquor from the LAW vitrification plant is received and neutralized in one vessel while being fed to the LAW evaporator separator vessel from another vessel. Additionally, off specification effluent may be received from the Plant Wash and Disposal System (PWD).~~

~~The two feeds to the LAW evaporator separator vessel are pumped continuously to the recirculation pump.~~

~~The recirculation pump maintains a high flow rate around the evaporation system. The recirculation pump transfers the waste through the reboiler and back into the LAW evaporator separator vessel. The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head to increase the boiling point above the temperature of the liquor in the reboiler.~~

The TLP feed system includes two LAW SBS C~~c~~ondensate R~~r~~eceipt V~~v~~essels (TLP-VSL-00009A/B) for managing submerged bed scrubber recycles from LAW vitrification and pretreatment process recycles. One vessel will be in an accumulation mode while the alternate vessel is feeding the T~~t~~reated LAW E~~e~~vaporator S~~s~~eparator V~~v~~essel (TLP-SEP-00001).

The design features of the recycle feed components include:

- Internal pulse jet mixers for solids suspension

~~Instrumentation for monitoring of vessel liquid level~~

~~Control system alarms and interlocks to prevent vessel overflow~~

- Instrumentation for monitoring of vessel liquid level ~~Vessel overflow to the plant wash vessel (PWD-VSL-00033)~~
- Vessel vent to the PVP system ~~to prevent pressurization of a vessel~~
- Passive air purge of the vessel vapor space
- Pump and line flushing capability
- Transfer flow rate indication and transfer volume totalizer
- Remote sampling capability off the discharge of the transfer pumps
- Vessel spray rings for vessel decontamination

The evaporator train has the capability to produce 30 gpm of process condensate. The ~~t~~Treated LAW E~~e~~vaporator S~~s~~eparator V~~v~~essel (TLP-SEP-00001) is a forced-circulation unit operating under vacuum to reduce the operating temperature. A recirculation pump maintains a high flow rate from the evaporator separator vessel to the R~~r~~eboiler (TLP-RBLR-00001). The pump transfers the waste through the ~~r~~Reboiler and back into the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001)~~evaporator separator vessel~~. The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head (submergence) above the reboiler tubes.

As the liquid travels ~~through~~ out of the ~~reboiler~~ Reboiler (TLP-RBLR-00001), the hydrostatic head diminishes and flash evaporation occurs as the flow enters the T~~t~~reated LAW ~~e~~Evaporator S~~s~~eparator V~~v~~essel (TLP-SEP-00001) ~~vessel~~. The liquid continues to flash and the vapor and liquid streams are separated (liquid-vapor disengagement). The liquid stream circulates in this ~~closed~~ loop ~~(~~and becomes~~ing~~ more concentrated~~)~~, while the vapor stream passes through a demisting section to the evaporator ~~overhead~~ condensing system. The concentrate off-take is pumped from the bottom of the ~~t~~Treated LAW E~~e~~vaporator S~~s~~eparator V~~v~~essel

(TLP-SEP-00001) at the controlled liquid density and is discharged to the TCP system as feed to LAW vitrification.

~~The concentrated waste stream is pumped continuously out of the evaporator system. The concentrate off-take is situated on the suction line of the recirculation pump. The concentrated waste stream is discharged to the treated LAW buffer vessels (V43110A/B/C).~~

The design features of the evaporator trains include:

- Operating pressure indication and control
- ~~Differential pressure indication across the Ttreated LAW Eevaporator Sseparator Vvessel (TLP-SEP-00001) demister section~~
- Differential pressure indication across the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) demister section
- Water sprays to the treated LAW ~~e~~Evaporator ~~s~~Separator vessel (TLP-SEP-00001) demister section
- Process condensate radiation monitoring and recycle capability
- Low~~-~~-pressure steam supply and conditioning for heating the R~~r~~eboiler (TLP-RBLR-00001)
- Reboiler (TLP-RBLR-00001) tube leak detection and diversion capability
- Reboiler (TLP-RBLR-00001) steam condensate collection
- ~~Instrumentation for monitoring and control of vessel liquid level~~
- Instrumentation for monitoring and control of vessel liquid level ~~Control system alarms and interlocks to prevent vessel overflow~~
- Passive venting via the down-stream vessels connected to the vent header
- Capability to drain, flush, and chemically clean the system

The vapor stream ~~from~~ exiting the T~~t~~reated LAW E~~e~~vaporator S~~s~~eparator V~~v~~essel (TLP-SEP-00001) is condensed in ~~the overheads system which contains~~ a ~~multi~~three-stage condenser system consisting of a P~~p~~rimary ~~condenser~~ Condenser (TLP-COND-00001), an I~~i~~nter-~~c~~Condenser (TLP-COND-00002), and an ~~aftercondenser~~ After-Condenser (TLP-COND-00003). A two-stage high-pressure steam vacuum system between the condensers maintains an operating pressure of approximately 1 psi on the T~~t~~reated LAW E~~e~~vaporator S~~s~~eparator ~~v~~Vessel (TLP-SEP-00001). The non-condensables ~~from~~ exiting downstream of the ~~aftercondenser~~ After-Condenser (TLP-COND-00003) ~~pass through the demister, which removes entrained droplets. The non-condensables~~ are ~~then~~ routed to the PVP system for treatment~~.~~.

Design features include:

Instrumentation for monitoring and control of vessel liquid level

~~Control system alarms and interlocks to prevent vessel overflow~~

- ~~Vessel overflow to a contingency vessel~~

- Vessel vent to the PVP system to prevent pressurization of a vessel
- Outlet valve header
- Remote sampling capability of the transfer pump discharge
- Dip legs in the vessel that maintain a liquid seal (pressure boundary) between the vessel and the condensers
- Makeup recycle water as required for startup

The condensed vapor from the ~~overheads system~~condensing unit is collected in ~~a condensate pot~~ the Treated LAW Evaporator Condensate Vessel (TLP-VSL-00002)~~condensate vesseland then transferred to process condensate vessels in the RLD for discharge to the ETF. If contaminated, the condensate from the system is recycled back through the TLP~~. A small fraction of the total condensate is recycled to the ~~t~~Treated LAW E~~e~~vaporator S~~s~~eparator ~~v~~Vessel (TLP-SEP-00001) demister water sprays. The balance of the condensate is transferred to the RLD system.

Condensate from the primary condenser is monitored ~~continuously~~ for activity. In the event of activity breakthrough being detected, a treated LAW evaporator separator system shutdown is initiated and the contents of the ~~evaporator condensate pot~~T~~t~~reated LAW E~~e~~vaporator C~~c~~ondensate V~~v~~essel (TLP-VSL-00002) are transferred to a LAW S~~submerged bed scrubber~~BS ~~purge~~ C~~c~~ondensate R~~r~~eceipt V~~v~~essels (TLP-VSL-00009A/B).

~~The evaporator recirculation pump will not automatically be stopped in case of a treated LAW evaporator process system shutdown. This is to prevent settling of solids within the recirculation loop, which may cause a blockage.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the TLP indicate or prevent the following conditions:~~

- ~~High level in separator vessel: Stop evaporator feed pumps.~~
- ~~Low level in separator vessel: Stop concentrate take-off pumps.~~
- ~~Breakthrough detected in condensate pot: Close clean condensate transfer valves and recycle contaminated condensate to receipt vessel.~~
- ~~Low level in condensate pot: Close condensate transfer valves.~~

The black cells and hot cell are partially lined with stainless steel for secondary containment, and are equipped with an instrumented sump or sumps for leak detection. The sumps are equipped with a steam emptying ejector.

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

~~Regulated pretreatment plant miscellaneous treatment system process and leak detection system instruments and parameters will be provided in Table III.10.G.C.~~

4.1.2.12 Treated LAW Concentrate Storage Process System (TCP)~~ System~~

Figure 4A-16 presents a simplified process flow diagram of the treated LAW concentrate storage process system (TCP). The primary functions of the TCP tank system ~~are~~ is to receive treated ~~waste~~ LAW concentrate from the ~~pretreatment process, to provide buffer storage capacity, and to transfer waste to the LAW vitrification plant~~treated LAW evaporation process system (TLP) and store the material for subsequent batch transfer to the LAW vitrification ~~facility~~plant. Dilute treated LAW direct from the cesium ion exchange process system (CXP) can also be received and stored in the TCP system (evaporator by-pass option). The ~~TCP t~~Treated LAW ~~C~~concentrate ~~S~~storage ~~v~~Vessel (TCP-VSL-00001) provides approximately 7 days of lag storage to sustain ILAW glass production ~~in the event~~if the pretreatment processing is interrupted.

Out-of-specification treated LAW concentrate can be recycled to the waste feed receipt process system (FRP) for rework through pretreatment, or recycled to the TLP system for blending and additional evaporation. Under strict administrative control (sampling and jumper installation), the ~~TCP t~~Treated LAW ~~C~~concentrate ~~S~~storage V~~v~~essel (TCP-VSL-00001) can also receive washed and leached solids directly from the UFP system if the solids meet treated LAW feed specification.

During commissioning, treated LAW concentrate may be stored in a dedicated FRP vessel for additional lag storage capacity. Transfers from and to the TCP and FRP systems will also be under strict administrative control (sampling and jumper installation).

The main components of the TCP tank system are:

- ~~One t~~Treated LAW ~~buffer~~ ~~C~~concentrate ~~S~~storage V~~v~~essel (~~V41001~~TCP-VSL-00001) ~~equipped with steam injection heating~~

~~□Pulse jet mixer~~

- ~~Transfer Two p~~Pumps ~~and associated piping~~for transferring treated LAW concentrate ~~(TCP-PMP-00001A/B)~~
- Three waste transfer lines to LAW vitrification
- Vessel inlet and outlet valve headers

Treated LAW concentrate is ~~normally received by the LAW buffer storage vessel from the treated LAW evaporator in the TLP~~batch--transferred from the tank to LAW vitrification through the inner pipe of any one of three co-axial transfer lines (two connected, one unconnected spare). The inlet and outlet valve headers and pumps are used in combination to facilitate circulation and sampling, forward transfer to LAW vitrification, and recycle to the TLP system or FRP system.

TCP system design features include:

- Capability to pressure test both the inner and outer transfer lines for integrity
- Transfer line leak detection system for integrity indication during transfer

~~Transfer line flushing and draining capability~~

- Transfer line flushing and draining capability ~~Control system permissive interlocks to preclude inadvertent transfer~~

~~Instrumentation for monitoring of vessel liquid level~~

~~Control system alarms and interlocks to prevent vessel overflow~~

- Instrumentation for monitoring vessel liquid level ~~Vessel overflow to a secondary receiver vessel for assurance of to ensure a minimum vessel vapor space (prevents overfill of a vessel)~~
- Vessel vent to the PVP system ~~to prevent pressurization of a vessel~~
- Direct steam injection to maintain the concentrate temperature above the saturation temperature (freezing point)
- Internal pulse jet mixers (PJMs) for solids suspension and slurry mixing
- Remote sampling capability off the discharge of the transfer pump
- Vessel spray rings for vessel decontamination
- Administrative controls and radiation monitoring ~~for assurance~~ to ensure that treated LAW transferred into and from the vessel meets waste specification for LAW vitrification.

The ~~T~~treated LAW ~~C~~concentrate ~~S~~storage ~~V~~vessel (TCP-VSL-00001) is designed for a 40-year life~~,~~ and is of welded stainless steel construction. The vessel is located in an inaccessible (black) cell. The cell is partially lined with welded stainless steel plate for secondary containment. This secondary containment will have a gradient designed to channel liquid to a low--point sump. The sump is equipped with liquid level instrumentation and is alarmed for detecting loss of vessel or piping integrity. Each sump is equipped with an emptying ejector.

The TCP system pumps and valve headers exposed to low radiation potential are located in a C3/R3 area for ease of maintenance. The radiation monitor and valves with potential exposure to elevated radiation are contained within a shielded bulge attached to the outside wall of the black cell. The bulge provides secondary containment and is equipped with decontamination sprays, liquid level instrumentation, a drain to the ~~u~~Ultimate ~~o~~Overflow ~~v~~Vessel (PWD-VSL-00033)~~, and filtered ventilation~~.

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

~~Pulsejet mixers will agitate the contents of the LAW buffer storage vessel. Agitation of tank contents ensures that solids in the treated LAW concentrate are suspended prior to transfer, improves heat transfer into the solution from steam injection, and prevents the settling of solids. The temperature of the LAW buffer storage vessel will be monitored and controlled with steam injection to avoid precipitation of solids.~~

~~Treated LAW concentrate will be transferred to the LAW vitrification plant via pipelines within underground trenches. A duty and standby pipeline will be installed to minimize disruptions to facility throughput in the event of a leak. The pipelines will be coaxial to detect and contain leaks. Following a treated LAW concentrate transfer, the pipe will be flushed with two pipe~~

~~volumes of water to clear the line and minimize the chance of the line blocking. The transfer pipe and annulus will drain to a Plant Wash and Disposal System (PWD) vessel.~~

~~The following list provides an overview of the safety and interlock features for the TCP:~~

~~□Normal operation control at high level: Stop PCS controlled transfer sequence.~~
~~□Failure of the PCS to stop transfer sequence: PCS software trip and alarm on PCS sources of feed.~~
~~□Failure of PCS software: If required, the hardwired trip would act on PCS sources of feed and on isolation valves.~~

4.1.2.13 Spent Resin Collection and Dewatering Process System (RDP)

Figure 4A-15 presents a simplified process flow diagram of the spent resin collection and dewatering process system (RDP). The RDP system provides for the periodic removal of spent ~~cesium and technetium~~ ion exchange resin ~~and the subsequent replacement with fresh resin~~.

The primary components of the RDP tank system include:

- ~~Two Three~~ S~~s~~pent ~~r~~Resin ~~collection~~ S~~s~~lurry V~~v~~essels (~~V43135~~RDP-VSL-00002A/~~-and V43135~~B/C)

~~□A resin flush collection vessel (V43136)~~

- Spent R~~R~~~~r~~esin D~~d~~ewatering M~~m~~oisture S~~s~~eparation V~~v~~essel (RDP-VSL-00004)
- Transfer pumps ~~and associated piping~~

The spent resin collection process is initiated by flushing an eluted Ce~~c~~esium I~~i~~on E~~e~~xchange C~~c~~olumn (CXP-IXC-00001/2/3/4) and hydraulically discharging the contents into ~~either of two~~a S~~s~~pent R~~r~~esin ~~collection~~ S~~s~~lurry V~~v~~essels (RDP-VSL-00002A/B/C). ~~In these vessels, the resin slurry will be circulated, monitored for cesium and technetium content, and delivered to a sampling system to determine whether the resin is in compliance with the receiving TSD unit's waste acceptance criteria.~~ Spent resin is removed from each Cesium Ion Exchange Column~~ion exchange column~~ independently as a batch operation. All three S~~s~~pent R~~r~~esin S~~s~~lurry V~~v~~essels (RDP-VSL-00002A/B/C) are interchangeable and will be capable of storing transport liquid and resin slurry.

Once in the spent resin slurry vessel, the resin slurry will be mixed by pulse jet mixers and monitored for radiation (gamma) content in a circulation loop to determine if elution has sufficiently removed radionuclides from the resin for disposal.

Resin that does not meet the predetermined treatment limits ~~for cesium and technetium content~~ will be routed back to the ~~cesium ion exchange columns~~Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4) for ~~re-~~additional elution. ~~Spent resins that meet the receiving TSD unit's waste acceptance criteria will be dewatered, containerized, and stored within the~~

~~pretreatment plant until transferred to a Hanford TSD unit.~~ After completing the additional elution, the resin is transferred back to a S~~s~~pent R~~r~~esin S~~s~~lurry V~~v~~essels (RDP-VSL-00002A/B/C/D) where it ~~again~~ begins processing again.

Following assurance that the spent resin is in compliance with the receiving TSD unit's acceptance criteria, the resin is pumped to the disposable spent resin dewatering container. When the transfer operation is completed, water is used to flush resin remaining in the transfer pump and line to the spent resin dewatering container.

There are three steps to resin dewatering. First, a gross dewatering removes excess water while the slurry is pumped to the container. Next, a dewatering pump is used to remove standing water from the resin bed. Finally, circulation of a warm, dry air stream through the spent resin evaporates the remaining liquid. The moist air stream leaving the dewatering container is cooled in the S~~s~~pent R~~r~~esin D~~d~~ewatering M~~m~~oisture S~~s~~eparation V~~v~~essel (RDP-VSL-00004) where the moisture is condensed and separated. The dry air from the spent resin dewatering moisture separation vessel is circulated past a heater and through the resin again. When the water content in the resin is reduced to an acceptable level, the operation is complete.

At times, internal decontamination of vessels may be required. The primary permanent process vessels are fitted with wash rings for decontamination by flushing. Wash systems will be able to introduce water, caustic solution, or acid. The ~~stainless~~ stainless- steel~~-clad~~- lined ~~cell is also fitted with a cladding wash system for decontamination of the walls and~~ floor provides secondary containment.

~~Spent Resin Removal~~

~~Spent resin is removed from each ion exchange column independently as a batch operation. Resin is first eluted and then hydraulically discharged under pressure from the ion exchange column by fluidizing the bed of resin with a flush liquor (demineralized water or caustic solution). The resin flush liquor is stored in the resin flush collection vessel and is delivered to the ion exchange columns by transfer pump.~~

~~Spent resin slurry from the ion exchange columns is collected in the two spent resin collection vessels. In order to obtain good resin fluidization and subsequent transfer to the resin dewatering container, water above the resin is recirculated through eductors installed inside each vessel at two levels. The function of the upper eductors located in the water above the settled resin bed is to create the jet mixing action and necessary velocity to initiate the mixing of resin and water. The lower eductors induce vortexes over the entire vessel volume to assure uniform suspension of the resin. Process water may be used as necessary to adjust the resin concentration. No additional fresh water is introduced into the vessels until lines are flushed at the end of a resin transfer.~~

~~The spent resin from the spent resin collection vessels is transferred to the dewatering container by recirculating the liquid through mixing eductors and into the resin bed at the bottom of the collection vessels. The recirculating resin is monitored for cesium (gamma) or technetium (beta) by radiation monitors to determine if cesium and technetium have been sufficiently removed~~

~~from the resin for disposal. Spent resin that contains cesium in excess of allowable limits is recycled to a cesium ion exchange column for an additional elution cycle. Spent resin that contains technetium in excess of allowable limits is recycled to a technetium ion exchange column for an additional elution cycle. After completing the additional elution cycle, the resin is transferred back to the spent resin collection vessels where it again begins recirculation. The spent resin is also analyzed to assure it complies with the receiving TSD unit's waste acceptance criteria.~~

~~Resin Dewatering~~

~~Following assurance that the spent resin is in compliance with the receiving TSD unit acceptance criteria, the pump discharge to the dewatering container is opened to fill the waste container to a predetermined level. When the transfer operation is completed, process water is used to flush resin remaining in the transfer pump and line to the dewatering container and the suction line is flushed back into the two spent resin collection vessels.~~

~~First, a gross dewatering removes excess water while the resin is pumped to the container and after it enters the container. Next, a dewatering vacuum pump is used to remove water from the resin. The container filtration system includes a moisture separator vessel. Circulation of a warm, dry air stream through the spent resin picks up moisture. The moist air stream is cooled and circulated to the moisture separation vessel where the moisture (water droplets) is separated. The blower sucks the dry air from the separation vessel and circulate the air to the resin again. When the water content in the resin is reduced to an acceptable level, the resin is dewatered.~~

~~The resin flush collection vessel receives flush liquor from the resin dewatering operation, and also receives resin transport liquor from the cesium and technetium ion exchange columns during the addition of fresh resin. The streams are stored for reuse as resin flush liquor. If the combined inputs into the resin flush collection vessel exceed its storage capacity, then the excess liquor is recycled to the Waste Feed Evaporator Process System (FEP). A resin flush transfer pump can be used to recirculate liquor to the resin flush collection vessel in order to mix the contents of the vessel and allow for sampling prior to transfer of the flush liquor to the resin flush collection vessel.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the RDP system to indicate or prevent the following conditions:~~

- ~~Overfilling: System Spent resin slurry vessels (RDP-VSL-00002A/B/C) and the dewatering containerspent resin dewatering moisture separation vessel (RDP-VSL-00004) are protected against overfilling by liquid level indication, high-level instrumentation interlocks to shut off feed sources, and PCS process control system control functions backed up by hard-wired trips as required. Overflow piping from each passively vented vessel prevents liquid from entering the pretreatment vessel vent process (PVP) system.~~
- ~~Loss of containment: Vessels are protected against containment loss by liquid level indication, and by PCS process control system control and alarm functions as required, including shut-off of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system. The cell floor is lined with stainless steel for secondary containment and sump liquid~~

~~level instrumentation will detect liquid leakage into in this system~~~~the cell. A steam ejector is used to empty the sump as needed.~~

- ~~Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or to the wrong location.~~
- ~~Loss of pumping function: Operation of pumps is not permitted or pumps are shut down if there is indication that the pumping system has plugged, lost its integrity, or ceased to function properly, or if pumping/receiving vessel conditions warrant a pump shutdown. These conditions could be indicated by:~~
  - ~~High or no electrical current indication~~
  - ~~Abnormal pumping/receiving vessel conditions~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

4.1.2.14 Pretreatment Maintenance

The pretreatment plant will include ~~a~~ maintenance faciliti~~y~~es that will enable remote and hands-on maintenance of ~~wet~~ process equipment, and will consist of the following systems~~.~~:

- Pretreatment ~~I~~in-~~C~~cell ~~Mechanical~~ ~~H~~handling ~~System~~ system (PIH)
- Pretreatment ~~Filter~~ filter ~~Cave~~ cave ~~Handling~~ handling ~~System~~ system (PFH)
- Radioactive ~~Solid~~ solid ~~Waste~~ waste ~~Handling~~ handling ~~System~~ system (RWH)

The individual systems and their primary functions are described below:

Pretreatment In-Cell ~~Mechanical~~ Handling System (PIH)
The purpose of this system is to ~~provide a method for~~decontaminate and perform~~ing~~ maintenance on process equipment in the ~~process gallery~~ hot cell. The equipment in the system will perform the following functions:

- ~~Lifting, holding, transporting, installing/uncoupling process equipment and failed in-cell cranes and powered manipulators~~
- Decontamination ~~and monitoring to~~of contaminated equipment using the ~~D~~decontamination ~~S~~soak ~~T~~tank (PIH-TK-00001)
- Providing fixtures for holding components while doing work
- Disassembling, repairing, and reassembling failed contaminated process equipment remotely

Typical process equipment that the system will handle are pumps, valves, jumpers, small vessels, and ancillary equipment and/or tools. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools ~~from the radioactive solid waste handling system~~.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors
- Size reduction equipment (cutters, shears, etc.)
- ~~Associated support~~Crane deployed equipment, ~~like~~ such as impact wrenches and spreader bars
- ~~Retrieval docking mechanism~~
- Fixtures
- ~~Fasteners~~
- Decontamination equipment (carbon dioxide, wash down, Decontamination S~~flushing,~~ ~~dunk~~soak T~~t~~ank~~)~~ (~~[~~PIH-TK-00001~~]~~))
- Manipulator-operated ~~A~~assembly/disassembly tools used in repair~~: these tools will be used by only the manipulators~~

Pretreatment Filter Cave Handling System (PFH)

The purpose of this system is to provide a method for performing maintenance on ventilation equipment in the filter cave~~ hot cell~~. The equipment in this system will provide the following functions:

- Lifting, holding, transporting, installing/uncoupling primarily filters, some process equipment, and failed in-cell cranes and powered manipulators
- Providing fixtures for holding components ~~for~~ while doing work
- Operation of some manual valves
- Decontamination and monitoring ~~to~~ of contaminated equipment
- Size reduction equipment (filter crushing)

Typical ~~process~~ ventilation equipment the PFH system will handle are HEPA filters and high~~-~~-efficiency mist eliminators ~~filters~~(HEMEs), and duct isolation valves, inside the cell. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors
- ~~Associated support~~Crane deployed equipment, ~~like~~ such as impact wrenches and spreader bars

~~□Retrieval docking mechanism~~
~~□Fixtures~~
~~□Fasteners~~

- Decontamination equipment (carbon dioxide, wash down)
- Manipulator-deployed ~~A~~assembly/disassembly tools used in repair~~: these tools will be used by only the manipulators~~

Radioactive Solid Waste Handling System (RWH)

The purpose of this system is to provide a means to dispose of ~~radioactive~~ mixed waste contaminated equipment. This system interfaces with ~~in-cell handling, filter cave handling~~system PIH, system PFH, and the spent resin dewatering system. The main functions ~~the~~ system RWH provides are:

- Lifting, holding, and transporting~~,~~ disposal containers
- Packaging disposal containers and preparing the containers for shipping
- ~~Decontamination of waste and c~~Cleaning and remote monitoring of disposal containers
- Temporary shielding and confinement barriers

Typical process and ventilation equipment the system will handle are failed process equipment, such as pumps and valves, filters, jumpers, and maintenance equipment.

Equipment in this system will include:

- Overhead cranes
- Manipulators (manual)
- Carts for transporting waste containers
- Associated support equipment, like impact wrenches and spreader bars
- Decontamination systems, such as carbon dioxide~~ and dunk tanks~~

~~□Fixtures~~

- Remote radioactive monitoring
- Temporary shielding and confinement barriers used for packaging
- Disposal containers

4.1.2.15 Plant Wash and Disposal System (PWD)

Figure 4A-17 presents a simplified process flow diagram of the plant wash and disposal system (PWD). The primary function of the PWD tank system is to receive, store, and transfer effluent. It will collect plant wash, drains, and acidic or alkaline effluent from the pretreatment plant.

The primary components of the PWD tank system include:

- C3 ~~f~~Floor D~~d~~rain C~~c~~ollection V~~v~~essel (PWD-VSL-00046)
- Acidic/~~A~~A~~a~~lkaline E~~e~~ffluent V~~v~~essels (~~V15013~~ PWD-VSL-00015/~~and V15018~~16)
- Plant W~~w~~ash ~~vessel~~ Vessel (~~V15009A~~PWD-VSL-00044)

~~Primary and secondary acidic/alkaline effluent vessels (V45013 and V45018)~~

~~C3 drain collection vessel (V15319)~~

- HLW E~~e~~ffluent ~~t~~Transfer ~~vessel~~ Vessel (~~V12002~~PWD-VSL-00043)
- Ultimate O~~o~~verflow V~~v~~essel (~~V15009B~~PWD-VSL-00033)
- Pumps, ~~and associated~~ piping, and instrumentation for waste transfers

~~Plant Wash Vessel~~Plant Wash Vessel (PWD-VSL-00044)

During operations, plant wash and drain effluents will be collected and mixed in with other effluents in the ~~plant wash vessel~~Plant Wash Vessel prior to transfer. The solution will be analyzed for pH and excess acidic effluent will be neutralized. Effluents will be recycled to the ~~waste feed evaporation process system (~~FEP system~~)~~.

The level~~, temperature, and pH~~ in the ~~plant wash vessel~~Plant Wash Vessel~~, as well as the temperature in each of the ten plant wash breakpots, are~~ (PWD-VSL-00044) is monitored ~~in the central control room~~. Pulse jet mixers are used to provide a uniform mixture during neutralization within the ~~plant wash vessel~~Plant Wash Vessel. Excess acidic effluent is neutralized with sodium hydroxide supplied from a reagent ~~bulge~~header. Wash rings are used for vessel ~~and breakpot~~ washing. Vessel-emptying ejectors may be used for transfers to the ~~secondary a~~Acidic~~c~~/A~~a~~lkaline E~~e~~ffluent V~~v~~essel (PWD-VSL-00016)~~ via a breakpot~~.

A reverse flow diverter supplies a representative sample of the contents of the ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044) for analysis. If the pH is confirmed to be ~~approximately 12 or~~ above a predetermined value, reverse flow diverters transfer the effluent from the ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044) to the ~~waste feed evaporator feed vessel~~Waste Feed Evaporator Feed Vessels (~~V11001~~FEP-VSL-00017A ~~or V11001~~/B). Normally, the contents of the ~~plant wash vessel~~Plant Wash Vessel ~~has priority over the primary and secondary acidic/alkaline effluent vessels when transferring effluent to the FEP~~is blended with the contents of the A~~acid~~/A~~a~~lkaline E~~e~~ffluent V~~v~~essels (PWD-VSL-00015/16) in the ~~waste feed evaporator feed vessel~~Waste Feed Evaporator Feed Vessels to maintain a consistent evaporator feed.

The ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044)~~, as well as the breakpots,~~ vents to the pretreatment vessel vent process system (PVP), via a ~~vessel~~ Vessel ~~v~~Vent ~~c~~Caustic ~~scrubber~~ Scrubber (PVP-SCB-00002) and the vessel vent header. An air in-bleed is provided to dilute hydrogen generated through radiolysis in the ~~plant wash vessel~~Plant Wash Vessel.

~~Acidic/Alkaline Effluent Vessels~~

~~High-activity acidic and alkaline effluent is received, stored, and neutralized in the primary acidic/alkaline effluent vessel or the secondary acidic/alkaline effluent vessel prior to transfer.~~

~~The primary and secondary acidic/alkaline effluent vessels will receive wastes from those sources listed on the process flow figures in Appendix 4A.~~

~~In both vessels, the acidic and alkaline effluents will be mixed to neutralize the effluents. The mixture will be analyzed and neutralized, if necessary. When the effluent meets the predetermined pH value, it will be transferred to the FEP, for recycling.~~

~~The system vessels are designed to withstand the anticipated heat of reaction generated by mixing the effluents. Normally, only low concentrations of acidic and caustic solutions will be mixed during operations, keeping the temperature within design limits. Higher concentrations of acidic and caustic effluents may be mixed during operations, with a greater increase in heat generation. The system will monitor temperature rise in the vessels and will automatically stop the effluent receipt when the temperature reaches a predetermined set point within design limits.~~

~~The level, temperature, and pH in the primary and secondary acidic/alkaline effluent vessels, as well as the temperature in each of the primary acidic/alkaline effluent breakpots and the secondary acidic/alkaline effluent breakpot, are monitored in the central control room. Pulse jet mixers are used to provide a uniform mixture during neutralization within these vessels. Excess acidic effluent is neutralized with sodium hydroxide supplied from a reagent bulge. Wash rings are used for vessel and breakpot washing. A vessel emptying ejector may be used for transfers to the plant wash vessel.~~

~~Reverse flow diverters supply a representative sample of the contents of the primary and secondary acidic/alkaline effluent vessels for analysis. If the pH is confirmed to be approximately 12 or above, reverse flow diverters transfer the HLW effluent from the primary and secondary acidic/alkaline effluent vessels to the FEP vessels.~~

Acidic/Alkaline Effluent Vessels (PWD-VSL-00015/16)

The Acidic/Alkaline Effluent Vessels~~acidic/alkaline effluent vessels~~ primarily receive ~~caustic scrubber purge from LAW vitrification and effluents from the TXP. The effluents are sampled, and if they meet acceptability requirements, they are sent to RLD. If it does not meet the requirements, the effluent is sent to the TLP~~alkaline-cleaning effluent from the UFP system, caustic rinse from the cesium ion exchange process system (CXP), and process condensate from the cesium nitric acid recovery process system (CNP). The effluents are sampled to confirm that the pH is above a predetermined value, and reverse flow diverters transfer the high-activity effluents to the W~~w~~aste F~~f~~eed E~~e~~vaporator Feed V~~v~~essels (FEP-VSL-00017A/B) for recycle.

The level~~, conductivity, radioactivity,~~ and ~~pH~~ temperature in the A~~a~~cidic/A~~a~~lkaline E~~e~~ffluent V~~v~~essels (PWD-VSL-00015/16) are monitored~~ in the central control room~~.

~~C3 Drain Collection Vessel~~

~~The C3 drain collection vessel receives floor drains and floor sumps from C3 areas. The effluents are transferred to the plant wash vessel for treatment.~~

HLW Effluent Transfer Vessel (PWD-VSL-00043)

The HLW ~~effluent~~ Effluent ~~transfer~~ Transfer ~~vessel~~ Vessel receives HLW acidic wastes from HLW vitrification line drains from HLW vitrification/pretreatment plant ~~interface~~ transfer lines, and laboratory drains. These effluents ~~can be~~are transferred to the ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044) to recover the effluents back into the process system.

C3 Floor Drain Collection Vessel (PWD-VSL-00046)

The C3 ~~f~~Floor ~~d~~Drain ~~c~~Collection ~~v~~Vessel receives floor drains and material from the sump in the local pit. Sampling capability has been provided but will not normally be used. This material will be transferred to the ~~a~~Alkaline ~~E~~effluent ~~V~~vessels (RLD-VSL-00017A/B). The C3 ~~f~~Floor D~~d~~rain C~~e~~ollection V~~v~~essel (PWD-VSL-00046) is vented locally through a high-efficiency particulate air filtration system.

Ultimate Overflow Vessel (PWD-VSL-00033)

The U~~u~~ltimate O~~o~~verflow V~~v~~essel receives overflows from vessels in the pretreatment plant. Additionally, this vessel receives line drains and flushes. The vessel operating level is maintained below a predetermined level to allow the vessel to hold 30 minutes of overflow at the highest transfer rate within the ~~facility~~plant.

The PWD vessels~~, as well as the breakpots,~~ vent to the PVP system via a vessel vent ~~c~~Caustic S~~s~~crubber (PVP-SCB-00002) and the vessel vent header. An air in-bleed is provided to dilute hydrogen generated through radiolysis in the PWD vessels.

~~Instrumentation, alarms, controls, and interlocks will be provided for the PWD to indicate or prevent the following conditions:~~

- ~~Overfilling. : Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS process control system control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.~~
- ~~Loss of primary containment. : Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS controls and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steelThe process control system generates a common alarm upon reaching the high alarm set point of the level instrument. The sump is emptied and returned to its normal operating status.~~
- ~~Inadvertent transfers of fluids. : System sequential transfer operations are interlocked.~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

~~Additional information for the PWD tank system is provided in the following documents located in Attachment 51, Appendix 8:~~

~~*Flooding Volume for PT Facility* (24590-PTF-PER-M-02-005)~~

~~*Sump Data for PT Facility* (24590-PTF-PER-M-02-006)~~

- ~~*System Logic Description for Pretreatment Facility - Plant Wash and Disposal System* (24590-PTF-PER-J-02-001)~~

4.1.2.16 Radioactive ~~and Non-Radioactive~~ Liquid Waste Disposal System (RLD ~~and NLD~~)

Figure 4A-18 presents a simplified process flow diagram of the radioactive liquid waste disposal system (RLD). The primary function of the RLD tank system is to receive, store, and transfer contaminated liquid effluents. The RLD system will receive low-activity ~~radioactive~~ mixed waste and/or dangerous waste effluents.

The primary components of the RLD tank system include:

~~□Two process condensate vessels (V45028A and V45028B)~~

- ~~Two~~ ~~P~~process ~~c~~Condensate ~~t~~Tanks (RLD-TK-00006A/B)
- ~~Two a~~Alkaline ~~E~~effluent ~~V~~vessels (RLD-VSL-00017A/B)
- Pumps, piping, and instrumentation for transfers

Alkaline Effluent Vessels (RLD-VSL-00017A/B)
These RLD vessels primarily receive~~s~~ effluent from the caustic scrubber purges from the LAW vitrification plant ~~via the PWD,~~ and waste feed from the C3 ~~F~~floor ~~D~~drain ~~C~~collection ~~V~~vessel (PWD-VSL-00046).

When these vessels reach a predetermined level, they are sampled, and if this material meets the LERF/ETF requirements it will be transferred to the ~~P~~process ~~C~~condensate ~~T~~tanks (RLD-TK-00006A/B). If the material does not meet LERF/ETF acceptance requirements, the material will be returned to the treated LAW evaporation process system (TLP) for reprocessing.

Process Condensate Tanks (RLD-TK-00006A/B)
Effluents are the condensed vapors removed from the waste streams by the pretreatment evaporators. Waste feed evaporator feed process (FEP)~~, overheads~~effluents and treated LAW evaporation process ~~the~~ (TLP) ~~overheads~~effluents are normally received directly into the Process Condensate Tank (RLD-TK-00006A). ~~These effluents are the condensed vapors removed from the waste streams via the PT evaporators. Liquid~~The effluents from the Process Condensate Tank (~~the systems will be~~RLD-TK-00006A) are recycled back into the process or discharged to the Process Condensate Tank (~~the Hanford Site LERF and then transferred to the ETF~~RLD-TK-00006B).

~~Prior to transfer to the LERF/ETF, t~~The effluent in the ~~p~~Process ~~c~~Condensate ~~t~~Tanks will be sampled, as needed, to ~~assure~~ demonstrate compliance with the LERF/ETF waste acceptance criteria ~~of the facility.~~ It may also be sampled should a process upset occur. If analysis determines that the effluent is outside the waste acceptance criteria, it will be returned to the ~~PWD~~ TLP for reprocessing.

~~Clean condensates may also be routed back to the pretreatment plant as process water makeup. Alternatively to discharging to the RLD, effluents from the pretreatment plant that are not radioactively contaminated and that designate as dangerous waste may be transferred to the NLD.~~

The Aalkaline Eeffluent ~~V~~V~~v~~essels ~~in the~~ (RLD-VSL-00017A/B) and Pprocess eCondensate tTanks (RLD-TK-00006A/B) ~~system will be~~ are vented to the PVP system.

~~Instrumentation, alarms, controls, and interlocks will be provided for the RLD~~ to ~~indicate or prevent the following conditions:~~

- ~~Overfilling: Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS process control system control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.~~
- ~~Loss of containment: Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS process control system control and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system, and a steam ejector is used for the sump around the alkaline effluent vessels (RLD-VSL-00017A/B) to empty the sump as needed. The cell around the alkaline effluent vessels (RLD-VSL-00017A/B) is lined with stainless steel for secondary containment. The sump around the process condensate tanks (RLD-TK-00006A/B) is a submersible electric pump and is used to empty the sump as needed. The process condensate tanks (RLD-TK-00006A/B) are located outside the PT facility in a diked area. This diked area is epoxy coated.~~
- ~~Inadvertent transfers of fluids: System sequential transfer operations are interlocked.~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

4.1.2.17 Pretreatment Plant Vessel Vent Process and Exhaust System (PVP/PVV)

Figure 4A-19 presents a simplified process flow diagram of the pretreatment plant vessel vent process and exhaust system (PVP/PVV). The pretreatment vessel vent process system (PVP) and exhaust system (PVV) provide the function of air purging of the head spaces of various process vessels for radiolytic hydrogen control, collection of vent exhausts from process vessels, and process treatment and filtration of the vessel vent exhaust gases before discharging to the PTF stack.

The ~~pretreatment plant offgas treatment systems~~PVP and PVV systems are composed of tanks and miscellaneous treatment systems, as follows ~~consist of the following major systems~~:

Tanks

- Vessel V~~v~~entilation HEME ~~high-efficiency mist eliminator~~ ~~d~~Drain C~~c~~ollection ~~v~~Vessel (PVP-VSL-00001)

Miscellaneous Unit Systems

- Caustic S~~s~~crubber (PVP-SCB-00002)
- High-~~e~~Efficiency ~~m~~Mist ~~e~~Eliminators ~~(HEMEs)~~ (PVP-HEME-00001A/B/C)
- Electric H~~h~~eaters (PVP-HTR-00001A/B/C)
- Air in-bleed HEPA ~~f~~Filters (PVP-HEPA-000023/24/28/29/30/31/32/33/34/35)
- Primary HEPA F~~f~~ilters (PVP-HEPA-00001A/B/C)
- Secondary HEPA F~~f~~ilters (PVV-HEPA-00002A/B/C)
- Volatile organic compound (VOC) O~~o~~xidizer U~~u~~nit (PVP-OXID-00001)
- After-C~~c~~ooler (PVP-CLR-00001)
- Carbon B~~b~~ed A~~a~~dsorbers (PVP-ADBR-00001A/B)
- Adsorber O~~o~~utlet ~~f~~Filter (PVP-FILT-00001)
- Pumps ~~(PVP-PMP-00001A/B and PVP-PMP-00002A/B)~~
- Exhaust F~~f~~ans (PVV-FAN-00001A/B)
- PVV stack

~~Pretreatment Vessel Vent Process System (PVP)~~
~~Process Vessel Vent Extraction (PVV)~~

The PVP and PVV systems have the following design features:

- Provides forced and passive purge air to remove radiolytic hydrogen~~.~~
- Collects vent gases from the process vessels~~.~~
- Treats the combined exhaust gases to adsorb soluble nitrogen oxide and acid gases, remove liquid droplets, condensate, mists, and solid particulates in the PVP system~~.~~
- Preheats vent gases to control relative humidity and removes ~~radioactive~~ particulates with two stages of HEPA filters~~.~~
- Provide additional treatment for the oxidation and removal of volatile organic compounds from the filtered exhaust gases in the PVP system. The filtered treated exhaust gases will then flow to the exhaust fans in the PVV system for venting to the atmosphere~~.~~

~~The PVP will treat two offgas streams. One stream will be from pretreatment vessel vents (tanks and other vessels), and the other stream will be exhaust from reverse flow diverters and pulsejet mixers. Both offgas streams will be collected and treated separately within the PVP. Following~~

~~treatment in the PVP, the offgas streams will proceed to the PVV where the streams will be sampled and discharged through separate flues within the pretreatment plant stack.~~

~~The functions of the PVP are to remove solids, liquid droplets, and mists from the offgas; prevent condensation in the HEPA filters; absorb soluble gases; and treat volatile organic gases. The ventilation systems upstream and downstream of the PVP are important to, and integral with, the functioning of the PVP. Upstream of the PVP will be an air inlet system that regulates air in-bleed rates to each process vessel. The motive force is provided by the ventilation fans downstream of the vessel vent system. The PVP, in combination with upstream and downstream systems, provides the radiolytic hydrogen control strategy for the pretreatment plant. The PVV will maintain continuous operation to provide the hydrogen control function, and will use backup power generators for the exhaust fans.~~

~~The offgas streams flow through a network of subheaders (piping) to two major collection headers. The two offgas streams will be separated because the reverse flow diverter/pulse jet mixer exhaust stream will have a much higher flow rate with a significantly lower concentration of radionuclides and volatile constituents then the vessel ventilations. Separating these two air streams will allow better control of pressures and exhaust airflow rates, as well as minimizing the size of emission-abatement equipment (volatile organic compounds oxidation unit, carbon beds, and scrubber).~~

~~The PVP will include a caustic scrubber, high efficiency mist eliminator (high efficiency mist eliminator), a volatile organic compounds oxidation unit, and carbon bed adsorbers. The reverse flow diverter/pulse jet mixer offgas is treated through a high efficiency mist eliminator before going to the PVV. After treatment in the PVP, both treated offgas streams will proceed, separately, to the PVV. The extract system for both streams includes a hot air injection system with electric heating coils and backflow HEPA filters. Downstream of the hot air injection the PVV includes HEPA filters, extract fans, stack air stream monitoring, and the exhaust stack. Although the volatile organic compounds oxidation unit and the carbon bed adsorbers will be part of the PVP, they will be located between the HEPA filters and the extract fans, both of which are part of the PVV.~~

~~The following sections provide descriptions of the PVP components:~~

- ~~Vessel vent header collection vessel (V15052)~~
- ~~Condensate collection vessel (V15038)~~
- ~~Two high efficiency mist eliminator drain collection vessels (V15326 and V15327)~~
- ~~Air inlet (air purge system)~~
- ~~Collection (exhaust piping system)~~
- ~~Vessel vent caustic scrubber~~
- ~~High efficiency mist eliminators and pre-heaters~~
- ~~Volatile organic compounds oxidation unit~~
- ~~Carbon bed adsorbers~~

~~Air inlet (air p~~Purge ~~system)~~air supply

~~Because the pretreatment process system design is an airtight design, the overall gas exhaust flow (except for evaporation, boiling, etc.) is directly dependent on the air purge rates provided to each individual process vessel.~~

Continuous air purge to process vessels is the primary control strategy for radiolytic produced hydrogen. Additional airflow above the minimum hydrogen control rate may be introduced to each vessel to help balance the system and ensure that vessels are obtaining the minimum required flow. ~~Additional airflow above the minimum for hydrogen dilution will also be introduced to individual vessels to remove heat by evaporative cooling. This function will help prevent boiling of self-heating tanks during an extended shutdown.~~

~~The air inlet header system is fitted with HEPA filters, isolation valves (to change HEPA filters if needed), balance and control valves to regulate flow, and a flow measurement device. Each inlet header will obtain air, at atmospheric pressure, from a C3 area and flow to a group of tanks supplied by that subheader. The supply lines are designed for the desired balance and total flow regulated at the inlet by the valves. The HEPA filters protect the C3 area from contamination in the event of reverse airflow, but airflows and balance will be designed to prevent reverse flow. The air inlet headers will supply air to groups of vessels, initially each process cell. The supply air arrangement will be independent of the exhaust air gathering system.~~

The ~~passive~~ purge air in-bleed to vessels in the pretreatment area is a passive feature. The process vessels located in the C5 ventilation area will draw passive purge air in-bleed from the C5 ventilation area near the vessels via subheaders. Other vessels located in the C3 ventilation area and ~~P~~process ~~C~~ondensate ~~T~~tanks (RLD-TK-00006A/B) located outside the pretreatment building will draw air in-bleed from the C3 ventilation area near the vessels through the inlet HEPA filters. The operating fan provides the motive force for airflow by maintaining a negative pressure in each vessel.

Forced purge air to the selected process vessels is also provided from the plant service air supply header during ~~the~~ normal and abnormal operations. Each of the selected process vessels is provided with the required airflow to control the hydrogen concentration below 1 % in the vessel during normal operation and below 4 % (lower flammability limit) during abnormal conditions. The supply line to each of these selected process vessels, which requires forced purge air during normal operation, is provided by two trains of valves and flow elements to meet the high reliability requirements.

For the Waste Feed ~~e~~Evaporator ~~s~~Separator ~~v~~Vessels (FEP-SEP-00001A/B) and the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001), which require forced purge air only during a shutdown or a loss of off-site power event, there are two separate trains of actuated valves and flow elements provided for each. The actuated valves for both of these trains are normally in closed position, but will fail open during the shutdown or loss of off-site power event.

Collection of vent gases (exhaust piping system)
From the individual process vessels~~,~~ a vent line routes exhaust gases to a subheader, usually one for each cell or group of vessels within a cell. The connection to the subheaders from the process vessels are arranged, where possible, to maintain airflow from normally lower activity vessels to (or past) normally higher activity levels vessels. ~~This will help prevent contamination of lower activity vessels due to potential reverse flow, or in-breathing. The subheader locations and the overall flow scheme will also be influenced by the plant layout and by the physical location of the major vessel vent headers.~~ Vent exhaust gases from various process vessels are combined to flow via subheaders to the C~~c~~austic S~~s~~crubber (PVP-SCB-00002). The vent gases from the vessels located in the C3 areas and the P~~p~~rocess C~~c~~ondensate T~~t~~anks (RLD-TK-00006A/B), located outside the pretreatment building, will be collected via other subheaders ~~which~~that combine into the common exhaust header. Any condensate formed in the common exhaust header will flow by gravity into Plant Wash V~~v~~essel (PWD-VSL-00044).

~~Final sizing of the individual exhaust vent lines will be determined by airflow, process pump capacities for filling vessels, and other potential pressurization scenarios. The individual exhaust vent lines, the subheaders, and the headers will also be sized to minimize overall pressure drop and help balance the system.~~

~~Vessel Vent~~ Caustic Scrubber (PVP-SCB-00002)
~~The vessel vent exhaust streams will be collected for treatment in the caustic scrubber. The scrubber removes radioactive aerosols, acid gases, and NO$_x$ emissions. The caustic scrubber will be a column with a bed filled with packing material. Sodium hydroxide solution flows down through the bed while the offgas enters the bottom and is drawn up through packing and caustic solution. Contact between the gas and the liquid in the bed causes a portion of the NO$_x$ in the vent gas to dissolve and form sodium nitrate. The scrubbing liquor collects in the sump of the column, and excess overflows to pretreatment effluent collection.~~

~~The caustic scrubber solution is recirculated by a pump. A pipe from the base of the scrubber leads to the pump suction and returns liquid to the column above the top of the packing. Above this point there is another packed section with very fine packing rings that acts as a disentrainment section to prevent caustic loss. There is a water wash ring above the disentrainment section in the column to wash accumulated caustic solid off the packing. Fresh caustic is supplied to the unit by a metering pump from the reagents system.~~

~~Demineralized water will be added to the scrubber, when needed, through the wash rings. Excess recirculation solution from the scrubber will be routed to pretreatment effluents. After leaving the scrubber, the offgas flows to the high efficiency mist eliminators. Positioning the scrubber ahead of the high efficiency mist eliminators saturates the gas flow and enables the high efficiency mist eliminators to avoid damage from dry operation. The scrubber is provided with a bypass line and valve. The bypass function is to permit continued operation of the hydrogen control system in the unlikely event the scrubber becomes plugged or disabled, or during maintenance activities.~~

~~The vessel vent caustic scrubber generates the liquid purge stream based on the absorption and cooling of the incoming vent exhausts from various vessels in the pretreatment plant. The vessel vent scrubber recirculation pump transfers, by batch, the scrubbing liquid purge stream once a day to the PWD. The scrubbing liquid purge stream transfers the accumulated condensate, radiolytic particulates and salts from the recirculating scrubbing liquid stream in the vessel vent scrubber.~~
The vessel vent exhausts flow into the C~~c~~austic S~~s~~crubber. The ~~c~~Caustic ~~s~~Scrubber is operated continuously to remove the nitrogen oxide and acid gases from the vessel vents. The vent gases flow to the inlet of the scrubber and flow upwards through a bed filled with packing. Alkaline scrubbing liquid flows down through the packed bed. Contact between the gas and the scrubbing liquid in the bed causes part of the nitrogen oxide and acid gases present in the vent offgases to react with the caustic in the scrubbing liquid and to adsorb and form sodium salts, which stay in solution. The scrubbing liquid solution is collected in the scrubber sump vessel located below the packed bed section of the scrubber.

Two scrubber recirculation pumps ~~(PVP-PMP-00001A/B)~~ (one operating and one in standby) continuously recirculate the scrubbing liquid solution to the top of the packed bed section of the scrubber. The operating pump also recirculates part of the solution directly into the sump vessel located below the scrubber to provide adequate mixing of the liquid in the vessel. The scrubber pump also transfers the collected condensate and scrubbing liquid normally once a day or on high level to the ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044). A section of dry packing located above the main packed section removes any entrained liquid droplets from the exit gases. A wash–water ring is provided above each of the packed sections to wash off any accumulation of solids. Fresh 5 molar caustic solution is added intermittently from the sodium hydroxide reagent process system (SHR). The caustic solution in the scrubber sump vessel is added intermittently to maintain the pH range for the scrubbing liquid recirculating to the top of the main packed section.

When needed, demineralized water is also added to the Caustic ~~s~~Scrubber wash rings to clean the dry packing or for makeup requirements. The level in the scrubber sump vessel is controlled between low and high operating level by batch transfer of the scrubber solution normally once every day to the ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044) in the PWD system.

The outlet gases from the Caustic Scrubber (PVP-SCB-00002)~~caustic scrubber~~ flow to the HEMEs. The inlet, outlet, and bypass valves are provided for the ~~vessel vent c~~Caustic ~~s~~Scrubber. The valves will be operated ~~with the use of crane or~~by a manipulator in the pretreatment filter cave area.

High–Efficiency Mist Eliminators (PVP-HEME-00001A/B/C) ~~and Pre-heater~~
The ~~high efficiency mist eliminator~~HEMEs will be composed of ~~regenerable~~ deep-bed fiber filter elements configured in an annular shape to remove fine aerosols. Vent gases from the scrubber flow into two HEMEs, with the third HEME available as standby. Gases flow~~s~~ from the outside to the inside hollow core~~, where t~~. The treated gas exits at the top and the liquid collects at the sealed bottom in a drainpipe. The ~~high efficiency mist eliminator~~HEMEs ~~will~~ are operated wet at all times ~~so that as~~to allow drainage of ~~the~~ soluble liquid aerosols ~~which~~that accumulate ~~they~~

in the fibers, form a liquid film~~, on the filter element,~~ ~~which then~~and drops to the drain line below to the Vessel Ventilation HEME D~~d~~rain C~~c~~ollection V~~v~~essel (PVP-VSL-00001). Continuous atomizing spray of demineralized water is provided at the gas inlet nozzle for each operating HEME. An ~~I~~intermittent ~~water~~ wash spray~~ing~~ of the filter elements will be used to ~~treat the vessel vent offgas stream~~remove any accumulated debris, thus extending the service life of the HEME elements. Intermittent washing will normally be carried out off-line.

Three separate ~~high efficiency mist eliminators~~HEMEs will treat the vessel vent offgas streams~~.~~ ~~The pulse jet mixer/reverse flow diverter has four separate high efficiency mist eliminators, three in-service, and one offline~~. This configuration will permit washing each ~~high efficiency mist eliminator~~HEME while it is offline. The ~~high efficiency mist eliminator~~HEME effluent will be discharged to ~~a~~ the Vessel Ventilation HEME D~~d~~rain C~~c~~ollection V~~v~~essel (PVP-VSL-00001) and then to ~~an effluent~~the ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044) in the PWD system.

~~After treatment in a high efficiency mist eliminator, the vessel ventilation offgas stream will be heated by the hot air injection system. The hot air injection system draws air through HEPA filters from a C3 area. The air is heated with an electric inline heater so that the combined air stream will be above its dewpoint to prevent condensation in the PVV HEPA filters. The HEPA filters in the hot air injection line protect against backflow of contamination into the C3 area and protect the heaters from contamination for maintenance.~~

~~The hot air injection system begins the PVV; it also includes HEPA filters, extract fans, stack air stream monitoring, and the exhaust stack. The volatile organic compounds oxidation unit and the carbon bed adsorbers will be part of the PVP, but they will be located between the HEPA filters and the extract fans, both of which are part of the PVV.~~

~~Volatile Organic Compound Oxidation Unit~~

~~To remove volatile organics compounds and in the vessel vent stream, a catalyst skid mounted unit with a thermal catalytic oxidizer unit will be used. In this unit, organic compounds are oxidized to carbon dioxide, water vapor, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream).~~

~~As the offgas enters the unit, it travels through the heat recovery unit, which is a plate heat exchanger. The heating medium used is the exhaust from the thermal catalytic oxidizer unit. The cool offgas enters the cold side of the heat recovery, then passes through an electric heater to bring the temperature up to that required for the volatile organic compound catalyst to operate.~~

~~Oxidation of organic compounds is an exothermic reaction therefore it significantly increases the offgas temperature. This hot offgas then enters the hot side of the heat recovery unit to heat the incoming offgas. The cooled offgas stream is then directed to the carbon bed adsorbers for further volatile organic compounds treatment.~~

Electric Heaters (PVV-HTR-00001A/B/C)
After treatment in HEMEs, the vessel ventilation offgas stream enters the PVV system where~~in~~ these gases will be heated by ~~e~~Electric ~~inline h~~Heaters (PVV-HTR-00001A/B/C) so that the exhaust gases will be preheated above their ~~dewpoint~~dew point to prevent condensation in the downstream PVV HEPA filters.

The PVV system also includes HEPA filters, exhaust fans, and the exhaust stack. The ~~volatile organic compounds~~VOC O~~o~~xidation U~~u~~nit (PVP-OXID-00001) and the C~~c~~arbon B~~b~~ed A~~a~~dsorbers (PVP-ABS-00001A/B) will be part of the PVP system, but they are located between the HEPA filters and the exhaust fans.

Primary HEPA Filters (PVV-HEPA-00001A/B/C)
The preheated vent exhaust gases from the heaters flow into one of the three P~~p~~rimary HEPA ~~f~~filters, which will be on line while the other two are available as standby offline. The HEPA filter will remove the ~~radioactive~~ particulates from the gas stream. The P~~p~~rimary HEPA F~~f~~ilters will be located in the pretreatment filter cave area (~~R~~room P-0335) for remote maintenance.

Secondary HEPA Filters (PVV-HEPA-00002A/B/C)
The gases from the ~~p~~Primary HEPA ~~f~~Filter flow into one of the three S~~s~~econdary HEPA F~~f~~ilters, which will be on line while the other two are available as standby offline. The S~~s~~econdary HEPA ~~f~~Filter will remove the ~~radioactive~~ particulates from the exhaust gases.

After the ~~p~~Primary and ~~s~~Secondary HEPA ~~f~~Filters remove the ~~radioactive~~ particulates from the vessel vent exhaust stream in the PVV system, the filtered vent exhaust stream returns to the PVP system for abatement of volatile organic compounds. The volatile organic compound abatement process functions to remove vapor--phase organic compounds from the PVP vent gas. This abatement process takes place within an oxidation system followed by an adsorption system. The oxidation system includes a VOC O~~o~~xidizer U~~u~~nit (PVP-OXID-00001) and an A~~a~~fter--C~~c~~ooler (PVP-CLR-00001). The adsorption system includes C~~c~~arbon B~~b~~ed A~~a~~dsorbers (PVP-ADBR-00001A/B) and a medium efficiency Adsorber Outlet ~~f~~Filters (PVP-FILT-00001A/B).

VOC Oxidizer Unit (PVP-OXID-00001)
To remove volatile organics compounds from the vessel vent stream, a skid--mounted electric, non-catalyzed oxidizer unit will be used. In this unit, volatile organic compounds are oxidized to carbon dioxide~~,~~ and water vapor at high temperature in the presence of excess oxygen.

The VOC ~~t~~Thermal ~~o~~Oxidizer will be a vendor--designed unit suitable for this specific application. By virtue of its heat recovery scheme, the unit is classified specifically as a regenerative thermal oxidizer. The oxidizer system will consist of three heat transfer beds, electric heat elements within the reaction section, and a downstream trim cooler (after--cooler). All high--temperature components of the system will be insulated to minimize heat losses.

Oxidation of organic compounds is an exothermic reaction; therefore~~;~~, it significantly increases the offgas temperature. The offgas then enters the heat recovery unit to transfer the heat to the bed, which will then be used for preheating the incoming offgas. The cooled gas stream is then directed to the A~~a~~fter-C~~c~~ooler (PVP-CLR-00001). The treated gases are cooled by the cooling water. Any condensate generated by cooling of the gases will flow to the C3 F~~f~~loor D~~d~~rain C~~c~~ollection V~~v~~essel (PWD-VSL-00046).

Carbon Bed Adsorbers (PVP-ADBR-00001A/B)
Two parallel C~~c~~arbon B~~b~~ed A~~a~~dsorbers are provided ~~in the design. The carbon beds will further reduce volatile organic compounds from the vessel vent offgas stream~~for the final treatment of vent gases. The adsorbers are filled with activated carbon. The adsorber will further reduce volatile organic compounds from the vessel vent exhaust gases. The ~~volatile organic compounds~~VOC ~~oxidation~~ Oxidizer ~~u~~Unit (PVP-OXID-00001) ~~is designed to~~will remove most of the volatile organic compounds from the vessel vent, and the Carbon Bed Adsorbers (PVP-ADBR-00001A/B)~~carbon beds~~ will remove the remaining volatile organic compounds~~. A bypass line and valve is included in the event both units are out of service or are not needed~~. Normal operation will be one unit online while the other is in maintenance ~~and regeneration~~ mode.

~~Typical safety design features included in the PVP/PVV are as follows:~~

- ~~The cell will be lined and provided with a washing system for decontamination purposes~~
- ~~The cell will be provided with a shielded access plug to allow the use of observation equipment~~
- ~~The design of the vessel vent lines will take into consideration the hydrostatic level (to prevent liquid from entering the system)~~
- ~~The collection piping conveying vent system offgases from the vessel vents, reverse flow diverters, and pulse jet mixers will be designed and routed in accordance with a process piping design guide~~
- ~~Traps will be fitted with water flush capability in order to clear potential line blockages~~
- ~~The local drainage sump will have an alarm/start set point to prevent flooding~~

Adsorber Outlet Filters (PVP-FILT-00001A/B)
The treated gases ~~form~~from the Carbon Bed Adsorbers (PVP-ADBR-00001A/B)~~adsorber~~ will flow into this filter, wherein fine carbon particles, if any are present in the vent gases, will be filtered. This filter is also provided with a bypass line and isolation valves to enable replacement of the filter.

Exhaust Fans (PVV-FAN-00001A/B)
After the filtration in the A~~a~~dsorber O~~o~~utlet F~~f~~ilters (PVP-FILT-00001A/B), the vent gases will flow into the ~~e~~Exhaust ~~f~~Fan in the PVV system. Two ~~e~~Exhaust ~~f~~Fans are provided. One will be in operation while the second one will be on standby. The ~~e~~Exhaust ~~f~~Fans provides the necessary motive force to extract the vent gases from the head spaces of various process vessels and provides for the required pressure drop through various treatment equipment in the PVP/ PVV systems. The ~~e~~Exhaust ~~f~~Fans will maintain a constant suction pressure at the inlet to the C~~c~~austic S~~s~~crubber (PVP-SCB-00002). The Exhaust Fans (PVV-FAN-00001A/B)~~fan~~ will have suitable speed control to accommodate variation in the vent gas flow rates from various vessels.

In addition to the i~~I~~nstrumentation, alarms, controls, and interlocks addressed in section 4.1.2, the following will be provided for the PVP/PVV systems to indicate or prevent the following conditions:

- Purge air flow measurement:
  - Passive purge air flow rate will be measured for the process vessels~~. There will also be~~ including low flow alarm for each of these flow instruments.
  - Forced purge air flow rate will be measured and low flow alarmed for the process vessels ~~which~~that require the control of hydrogen concentration. These instruments will have important-to-safety instrument function. ~~There will also be low flow alarm for each of these flow instruments.~~
  - ~~For the caustic scrubber (PVP-SCB-00002), the liquid level will be monitored and maintained within the low and high level limits. The scrubbing liquid transfer can notcannot open if the liquid level is below the low operating level during normal operation. The scrubbing liquid transfer valve can notcannot be opened if the receipt vessel (plant wash vessel PWD-VSL-00044) is not aligned or ready to receive the transfer of scrubbing liquid.~~
- For the HEMEs:
  - ~~, t~~The outlet pressure, pressure drop, and the flow rates will be monitored and controlled.
  - ~~-~~Demineralized water supply for HEMEs will ~~also~~ have monitoring for the inlet pressure and flow rates.
  - ~~Actuated valve for demineralized water inlet to the HEME can notcannot stay open if there is a high level alarm in the HEME.~~
- ~~For the HEME drain collection vessel (PVP-VSL-00001), the liquid level will be monitored and maintained within the low and high level limits. The liquid transfer valve can notcannot be opened to transfer HEME drains if the plant wash vessel (PWD-VSL-00044) is not aligned or ready to receive the transfer of liquid.~~
- For the HEPA filters, the pressure drop will be monitored and controlled within the required limits.
- For the VOC O~~o~~xidizer U~~u~~nit (PVP-OXID-00001):
  - ~~, t~~The thermal oxidizer reaction zone, the outlet temperatures, and the pressure drop will be monitored and controlled.
  - ~~-Also, t~~The oxidizer bypass valve cannot be opened unless the reaction zone temperature has been attained.
- For the carbon bed adsorber:
  - ~~, t~~The pressure drop through the bed will be monitored and controlled.
  - The differential temperature across the carbon bed will ~~also~~ be monitored.
- For the adsorber outlet filter, the pressure drop will be monitored and controlled.

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

~~Regulated pretreatment plant miscellaneous treatment system process and leak detection system instruments and parameters will be provided in Table III.10.G.C.~~

4.1.2.18 Pulse Jet Ventilation System (PJV)

Figure 4A-128 presents a simplified process flow diagram of the pulse jet ventilation system (PJV). The pulse jet ventilation system (PJV) provides the safety function to treat the exhausts from reverse flow diverters and pulse jet mixers operating inside various process vessels before release to the atmosphere via the pretreatment plant stack. The PJV system consists of process and HVAC equipment for removal of aerosols and ~~radioactive~~ particulates. The PJV system is composed of tanks and miscellaneous treatment systems, as follows:

Tanks

- PJV HEME ~~d~~Drain ~~c~~Collection ~~v~~Vessel (PJV-VSL-00002)

Miscellaneous Treatment Systems

~~Demisters (PJV-DMST-00002A/B/C)~~

- Demisters (PJV-DMST-00002A/B/C)~~Pumps (PJV-PMP-00001A/B)~~
- Air ~~I~~in-~~B~~bleed ~~f~~Filters (PJV-FLTH-00001A/B)
- ~~Air in-bleed~~Electric ~~H~~heaters (PJV-HTR-00001A/B)
- A~~Air~~ ~~I~~in-~~b~~Bleed HEPA ~~f~~Filters (PJV-HEPA-00003A/B)
- P~~Primary~~ HEPA ~~f~~Filters (PJV-HEPA-00001A/B/C/D/E/F/G)
- S~~Secondary~~ HEPA ~~f~~Filters (PJV-HEPA-00002A/B/C/D/E/F)
- Exhaust ~~f~~Fans (PJV-FAN-00001A/B/C)
- Pumps

The PJV system provides the containment and confinement of exhausts from various reverse flow diverters and pulse jet mixers operating inside the PTF process vessels. This system provides the removal of mists and aerosols from the combined PJV exhausts stream by demisters (medium–efficiency mist eliminators). The treated exhaust gases are mixed with hot air in-bleed from the C3 ventilation area to adjust their relative humidity, followed by two stages of HEPA filtration to remove ~~radiolytic~~ particulates. The filtered effluent gases flow to the Exhaust Fans (PJV-FAN-00001A/B/C)~~PJV exhaust fans~~. The treated filtered exhausts stream will be monitored before it is discharged to the atmosphere.

Collection of Exhaust Gases (Exhaust Piping System)

The PJV system receives the exhaust via several sub-headers from the reverse flow diverters and pulse jet mixers operating in various process vessels in the pretreatment area. The exhausts are combined from various sub-headers to flow via the inlet header to the D~~d~~emisters (PJV-DMST-00002A/B/C). The low points of the inlet header and sub-headers are provided with drain lines, which drain condensate collected in the header to the PJV HEME ~~d~~Drain C~~c~~ollection V~~v~~essel (PJV-VSL-00002). This vessel is also provided with an overflow, which will flow to the U~~u~~ltimate O~~o~~verflow V~~v~~essel (PWD-VSL-00033) in the pretreatment plant wash and disposal system (PWD). The condensate from the PJV HEME D~~d~~rain ~~c~~Collection ~~v~~Vessel (PJV-VSL-00002) is periodically transferred by the drain transfer pumps ~~(PJV-PMP-00001A/B)~~ to the ~~plant wash vessel~~Plant Wash Vessel (PWD-VSL-00044) in the PWD system.

Demisters (PJV-DMST-00002A/B/C)

The PJV system is provided with three D~~d~~emisters (PJV-DMST-00002A/B/C), which are medium--efficiency mist eliminators. Two of these demisters are in service at a given time and one is available as a standby off-line.

Demisters are used to remove fine aerosols and mist, and exhibit medium removal efficiencies for sub-micron aerosols. They are passive devices with low maintenance requirements and high reliability. The demisters will adequately protect the HEPA filters, located downstream in this system, from excessive activity buildup, and provide the desired HEPA filter life of 4 to 5 years.

All D~~d~~emisters (PJV-DMST-00002A/B/C) for this system are located, along with the HEPA filters, in the filter cave (r~~R~~oom P-0335) in a C5 ventilation area due to the expected radionuclide loading. The ~~d~~Demisters (PJV-DMST-00002A/B/C) are isolated, or put into service, by opening or closing isolation valves provided at the inlet and outlet of each ~~d~~Demister. These isolation valves are operated remotely by using the manipulator and the filter cave operating crane. The headers are designed without any bypass around the ~~d~~Demisters (PJV-DMST-00002A/B/C) to prevent the downstream HEPAs from accelerated loading of ~~radionuclide~~ particulates. Remote ~~changeout~~change out capability for the ~~d~~Demister filter elements is provided.

The outlet gases from the ~~d~~Demisters (PJV-DMST-00002A/B/C) flow to the outlet header to the extract part of the PJV system, as described below.

Hot Air In-Bleed

Air in-bleed from a C3 ventilation area is filtered, heated, and then mixed with the exhaust gases from the ~~d~~Demister outlet for reducing the relative humidity of the stream flowing into the primary HEPA ~~f~~Filter banks. The in-bleed air is filtered with medium efficiency Air In-Bleed ~~f~~Filters (PJV-FLTH-00001A/B) and then heated to the temperature required to keep the humidity of the mixed gases below 70 % and prevent the wetting of the HEPA ~~f~~Filters.

There are two E~~e~~lectric ~~h~~Heaters (PJV-HTR-00001A/B) arranged in parallel, one working and the other as standby, to provide the required heating of in-bleed air. Hot air in-bleed flows from the ~~e~~Electric ~~h~~Heaters to ~~a~~Air ~~i~~In-~~b~~Bleed HEPA ~~f~~Filters (PJV-HEPA-00003A/B), one working and the other as standby. These provide protection against backflow of the PJV exhausts stream into the in-bleed system in the C3 ventilation area.

Primary Exhaust HEPA Filters (PJV-HEPA-00001A/B/C/D/E/F/G)
There are seven ~~p~~Primary HEPA ~~f~~Filter banks, arranged in parallel and configured in a running/ standby arrangement to allow on-line filter change. There will be five ~~p~~Primary HEPA ~~f~~Filters in operation, and two Primary HEPA ~~f~~Filters will be on standby or in maintenance. The ~~primary~~ Primary HEPA ~~f~~Filters will be remote change type located in the pretreatment filter cave area. Filter inserts are radial type. Inlet and outlet isolation valves for the HEPA ~~f~~Filters are remotely operated by a manipulator and maintenance crane in the pretreatment filter cave (r~~R~~oom P-0335).

Secondary ~~Exhaust~~ HEPA Filters (PJV-HEPA-00002A/B/C/D/E/F)
Exhaust gases from the ~~p~~Primary HEPA ~~f~~Filters are routed to the outlet header, then to the ~~s~~Secondary ~~exhaust~~ HEPA ~~f~~Filters located in a C3 ventilation area. There are six ~~s~~Secondary HEPA ~~f~~Filter banks, arranged in parallel and configured in a running/standby arrangement to allow on-line filter change. There will be four S~~s~~econdary HEPA~~s~~ Filters in operation, and two Secondary HEPA ~~f~~Filter banks will be on standby or in maintenance. Secondary HEPA ~~f~~Filters will be the safe change type.

PJV Exhaust Fans (PJV-FAN-00001A/B/C)
The filtered exhausts from the ~~s~~Secondary HEPA ~~f~~Filters will flow to three ~~e~~Exhaust ~~f~~Fans. Two fans will be in operation while the third fan will be on standby. The ~~e~~Exhaust ~~f~~Fans provide the necessary motive force to extract the vent gases from the fluidics discharge racks and provide for the required pressure drop through the treatment equipment in the PJV system. The ~~e~~Exhaust ~~f~~Fans (PJV-FAN-00001A/B/C) will maintain a constant suction pressure condition for the inlet gas stream to the ~~d~~Demisters. The ~~fans~~Exhaust Fans will have suitable speed control to accommodate variation in the exhaust flow rates from reverse flow diverters and pulse jet mixers operating inside various vessels.

In the event of failure of one of the two ~~e~~Exhaust ~~f~~Fans in operation, the standby fan automatically starts. Each fan is provided with manual isolating dampers on the fan inlet and pneumatic actuated isolating dampers on the fan outlet. From the PJV ~~e~~Exhaust ~~f~~Fans, pulse jet mixer and reverse flow diverter treated effluents flow via a dedicated, continuously monitored flue to the PTF stack.

In addition to the ~~I~~instrumentation, alarms, controls, and interlocks addressed in section 4.1.2, the~~will~~ following will be provided for the PJV system to indicate or prevent the following conditions:

- Flow rate for the combined exhaust gas entering the ~~d~~Demisters (PJV-DMST-00002A/B/C) will be monitored. Suction pressure for the inlet gas will be maintained by varying the speed for the ~~e~~Exhaust ~~f~~Fans (PJV-FAN-00001A/B/C)~~.~~

~~Pressure drop for the dDemisters (PJV-DMST-00002A/B/C) will be monitored.~~

- Pressure drop for the Demisters (PJV-DMST-00002A/B/C) will be monitored ~~Liquid level in the PJV drain collection vessel (PJV-VSL-00002) will be monitored and maintained within low and high operating limits.~~

- Each HEPA filter bank ~~is~~will be monitored and alarmed on high differential pressure~~.~~

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

~~Regulated pretreatment plant miscellaneous treatment system process and leak detection system instruments and parameters will be provided in Table III.10.G.C.~~

4.1.2.19 Sodium Hydroxide Reagent System (SHR)

Figure 4A-129 presents a simplified process flow diagram of the sodium hydroxide reagent system (SHR). The ~~f~~Feed ~~l~~Line ~~f~~Flush ~~t~~Tank (SHR-TK-00009) of the SHR system is used to make up solutions for flushing the coaxial waste transfer lines between PTF and the DST system.

The main components of the SHR tank system are:

- Feed ~~l~~Line ~~f~~Flush ~~t~~Tank (SHR-TK-00009)
- Pump and ~~a~~Associated piping for transfer ~~(pump used is FRP-PMP-00001)~~

Sodium nitrite, sodium hydroxide, and process condensate are mixed together in the feed line flush tank for a feed line flush solution. The waste feed return pump transfers the solution through the line. A mechanical agitator provides mixing capabilities for the solution. The Feed Line Flush Tank~~tank~~ will be equipped with level instrumentation to indicate when to begin and end transfers to the waste feed lines. The Feed Line Flush Tank~~tank~~ is located in a C3/R3 area. Exhaust from the Feed Line Flush Tank~~tank~~ will pass through a HEPA filter for contamination control.

~~Regulated pretreatment plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.E.~~

4.1.2.20 Pretreatment Plant Ventilation

Pretreatment plant ventilation includes the following systems:

- C1 v~~V~~entilation s~~S~~ystem (C1V)
- C2 v~~V~~entilation s~~S~~ystem (C2V)
- C3 v~~V~~entilation ~~S~~system (C3V)
- C5 v~~V~~entilation s~~S~~ystem (C5V)

The primary consideration in the design of the ventilation systems is to confine airborne sources of contamination to protect human health and the environment from exposure to hazardous materials during normal and abnormal operating conditions. Physical barriers or structures supported by the ventilation systems will ensure ~~that before~~ air ~~is~~ released to the environment and residual contamination is well below acceptable, safe levels for public exposure.

The pretreatment plant will be divided into four numbered zones, listed below, with the higher number indicating greater radiological hazard potential that needs greater control or restriction. The ventilation system zoning is based on the classifications assigned to building areas for potential contamination. Zones classified as C5 are potentially the most contaminated, such as the pretreatment cells. Zones classified as C1 are uncontaminated areas.

The confinement provided by physical barriers is enhanced by the ventilation system, which creates a pressure gradient and causes air to flow through engineered routes from an area of lower contamination potential to an area of higher contamination potential. There will be no C4 areas in the pretreatment plant. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and, hence, the amount of air requiring treatment.

C1 Ventilation System (C1V)

C1 areas are normally occupied. C1 areas will typically consist of administrative offices, control rooms, conference rooms, locker rooms, rest rooms, and equipment rooms. C1 areas will be operated slightly pressurized relative to atmosphere and other adjacent areas.

C2 Ventilation System (C2V)

C2 areas typically consist of non-process operating areas, access corridors, and control/ instrumentation, and electrical rooms. Filtered air will be supplied to these areas by the C2 supply system and will be cascaded into adjacent C3 areas or HEPA filtered and exhausted by the C2 Exhaust system.

C3 Ventilation System (C3V)

C3 areas normally will be unoccupied, but operator access during maintenance will be allowed. C3 areas typically will consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Access from a C2 area to a C3 area will be via a C2/C3 subchange room. Air will generally be drawn from C2 areas and cascaded through the C3 areas into C5 areas. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. In some areas, where higher flow may be required into C3 areas, a dedicated C2 supply will be provided with a backdraft damper on the C2 supply duct, which will be closed in the event of a loss of C3 extract. This system will shut down should there be a failure of the C5 ~~E~~exhaust ~~s~~System.

C5 Ventilation System (C5V)

The pretreatment plant C5 areas are designed with the cell or cave perimeter providing radiation shielding as well as a confinement zone for ventilation purposes. C5 areas typically consist of a series of process cells where waste will be stored and treated. The pretreatment plant hot cell will house major pumps and valves and other process equipment. Air will be cascaded into the C5 areas, generally from adjacent C3 areas, and extracted by the C5 extract system. The C5 ~~E~~exhaust ~~S~~system will be composed of ~~Pp~~Primary (PVP-HEPA-00001A/B/C) and ~~sS~~Secondary (PVP-HEPA-00002A/B/C) HEPA ~~filters~~ Filters and variable speed Exhaust ~~f~~Fans (PJV-FAN-00001A/B/C). Fans designed to maintain continuous system operation will drive the airflow. This system will also be interlocked with the C3 HVAC system, to prevent backflow by shutting down the C3 system if the C5 HVAC system shuts down.

4.1.3 LAW Vitrification

The purpose of this section is to describe the major systems associated with the LAW vitrification plant. Figure 4A-3 presents a simplified process flow diagram of the LAW vitrification processes. This plant will consist of several process systems designed to perform the following functions:

- Store pretreated LAW ~~waste slurry~~feed
- Convert blended LAW ~~waste slurry~~feed and glass formers into ~~molten~~ glass
- Provide melter offgas treatment systems
- ~~Provide ILAW container handling systems~~Treat melter offgas
- ~~Provide~~ Handle ILAW container~~s finishing systems~~
- ~~Provide storage areas for~~Store ILAW containers
- Provide supporting equipment ~~for~~ in the melter cave
- ~~Provide~~ Handle miscellaneous waste ~~handling systems~~
- ~~Provide~~ Ventilate the LAW vitrification plant ~~ventilation systems~~

~~Figure 4A-1 presents the simplified flow figure for the WTP, Figure 4A-3 presents the simplified flow of primary process systems, and t~~The following figures located in Appendix 4A and drawings found in DWP ~~Appendix 4A~~Attachment 51, Appendix 9, provide additional detail for the LAW vitrification plant:

- Simplified flow diagrams for the WTP and the LAW vitrification plant
- ~~Simplified p~~Process flow figures and drawings for process information
- Typical system figures depicting common features for each regulated system
- ~~Simplified g~~General arrangement figures and drawings showing locations of regulated equipment ~~and associated tanks~~

~~□Waste management area figures and drawings showing plant locations to be permitted~~

- Waste management area figures and drawings showing plant locations to be permitted

~~□Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant~~

Instrumentation, alarms, controls, and interlocks will be provided for the tank systems and miscellaneous treatment sub-systems to indicate or prevent the following conditions, as appropriate:

- Overfilling: Plant items are protected against overfilling by liquid level indication, high level instrumentation interlocks to shut off feed sources, and process control system control functions backed up by hard wired trips as required.

- Loss of containment: Plant items are protected against containment loss by liquid level indication, and by process control system control and alarm functions as required, including shut off of feed sources. Each plant item that manages liquid mixed or dangerous waste is provided with secondary containment. Sumps associated with the management of mixed or dangerous waste are provided with liquid level instrumentation and an ejector or pump to empty the sump as needed.

- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or to the wrong location.

In addition to level control, temperature and pressure may be monitored for tank systems and miscellaneous treatment systems in some cases. Additional information may be found in the system logic descriptions located in DWP Attachment 51, Appendix 9.13. Regulated process and leak detection system instruments and parameters will be provided in DWP Table III.10.E.F for tank systems and in DWP Table III.10.H.C for miscellaneous treatment sub-systems.

Descriptions of the LAW vitrification process, melter offgas treatment systems, and ILAW glass container handling systems are provided in the following sections.

4.1.3.1 LAW Melter Feed Process

The LAW melter feed consists of the following systems:

- LAW concentrate receipt process system (LCP)
- LAW melter feed process system (LFP)
- Glass former reagent system (GFR) (the GFR system does not manage dangerous waste and is provided for information only)

Figure 4A-20 presents a simplified process flow diagram of the LAW concentrate receipt process system (LCP) and the LAW melter feed process system (LFP). The LCP and LFP systems prepare feed for the LAW melters to produce a vitrified product. An analysis of the waste determines a glass additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste. There are ~~three~~ two melter feed trains to supply the ~~three~~ two LAW melters. Each melter feed train consists of a melter concentrate receipt vessel, a melter feed preparation vessel, and a melter feed vessel. The LCP system includes the melter concentrate receipt vessels. The LFP system includes the melter feed preparation vessel and the melter feed vessel for each of the ~~three~~ two melters.

The ~~LAW melter feed~~ LCP tank system consists of the following vessels and their associated ancillary equipment:

- Melter ~~concentrate~~ Concentrate ~~receipt~~ Receipt ~~vessels~~ Vessels (~~V21001, V21002, V21003~~LCP-VSL-00001/2)

The LFP tank system consists of the following tanks and their associated ancillary equipment:

- Melter ~~feed~~ Feed ~~preparation~~ Preparation ~~vessels~~ Vessels (~~V21101, V21201, V21301~~LFP-VSL-00001/3)
- Melter ~~feed~~ Feed ~~vessels~~ Vessels (~~V21102, V21202, V21302~~LFP-VSL-00002/4)

Melter Concentrate Receipt Vessels (LCP-VSL-00001/2)
The ~~melter~~ Melter ~~concentrate~~ Concentrate ~~receipt~~ Receipt ~~vessels~~ Vessels receive melter feed concentrate from the pretreatment plant. The ~~melter~~ Melter ~~feed~~ Feed ~~preparation~~ Preparation ~~vessels~~ Vessels are located in ~~three~~ two process cells, and each process cell contains a ~~m~~Melter ~~concentrate~~ Concentrate ~~receipt~~ Receipt ~~vessel~~Vessel, a ~~m~~Melter ~~feed~~ Feed ~~preparation~~ Preparation ~~vessel~~Vessel, and a ~~melter~~ Melter ~~feed~~ Feed ~~vessel~~Vessel. ~~Each~~ The vessels ~~is~~ are equipped with the following:

- Mechanical agitator
- ~~Two p~~Pumps to transfer LAW concentrate
- Instrumentation for liquid level ~~and density measurement~~

~~□Liquid level instrument~~

~~□Thermowell/temperature sensor for temperature measurement~~

- Internal spray wash ~~rings~~nozzles
- Overflow to C3/C5 ~~drains~~Drains/~~sump~~ Sump ~~collection~~ Collection ~~vessel~~ Vessel (RLD-VSL-00004)
- Spare nozzles

Valves are located in the valve bulge. Valving in each bulge allows the LAW concentrate to be routed to the ~~m~~Melter ~~feed~~ Feed ~~preparation~~ Preparation ~~vessels~~ Vessels (LFP-VSL-00001/3), or to the ~~plant~~ Plant ~~wash~~ Wash Vessel (RLD-VSL-00003) ~~vessel~~ if the ~~m~~Melter ~~concentrate~~ Concentrate ~~receipt~~ Receipt ~~vessel~~ Vessels (LCP-VSL-00001/2) ~~is~~ are being cleaned out or if the contents of ~~that~~ the vessels cannot be satisfactorily processed. In addition, LAW concentrate can be pumped between the two ~~m~~Melter ~~c~~Concentrate ~~r~~Receipt ~~v~~Vessels (LCP-VSL-00001/2).

Glass Former Reagent System (GFR)
The GFR system contains the glass former feed hoppers that receive blended glass formers and sucrose by dense-phase pneumatic conveyors from the ~~LAW transporters located at the~~ glass formers ~~room~~system. ~~Each feed hopper is equipped with a pneumatic blending head at the base of the hopper to re-blend the glass former feed.~~

The feed hoppers are equipped with filters to remove the dust from air used for pneumatic conveying and blending. It is anticipated that a series of single filter cartridges will be mounted on the top of the hoppers. The filters are cleaned by introducing compressed air through the cleaning nozzle to blow accumulated dust back into the hoppers.

The feed hoppers are equipped with load cells to weigh the glass formers to confirm that the material in the upstream blending silo is conveyed to the feed hoppers and to confirm that the glass formers are transferred out of the feed hoppers to the Melter Feed Preparation Vessels (LFP-VSL-00001/3)~~melter feed preparation vessels~~.

~~After the blending cycle t~~The glass formers are gravity-fed with a rotary feeder into the Melter Feed Preparation Vessels (LFP-VSL-00001/3)~~melter feed preparation vessels~~, where the ~~blended~~ glass formers are mixed with the waste feed. This equipment is located in an isolated area that serves as a contamination barrier between the melter feed preparation vessels and the glass former supply. The rotary valve controls the rate of glass former addition into the melter feed preparation vessels.

Melter Feed Preparation Vessels (LFP-VSL-00001/3)
The ~~melter~~ Melter ~~feed~~ Feed ~~preparation~~ Preparation ~~vessels~~ Vessels mix LAW concentrate from the ~~melter~~ Melter ~~concentrate~~ Concentrate ~~receipt~~ Receipt ~~vessels~~ Vessels (LCP-VSL-00001/2) with glass formers and sucrose from the glass former feed hoppers. The vessels are equipped with the following:

- Mechanical agitator
- ~~Two p~~Pumps
- Instrumentation for liquid level ~~and density~~ measurement
- ~~Liquid level instrument~~
- ~~Thermowell/temperature sensor for temperature measurement~~
- Internal spray wash ~~rings~~nozzles
- Overflow to the ~~cell sump~~C3/C5 ~~d~~Drains/~~s~~Sump ~~c~~Collection ~~v~~Vessel (RLD-VSL-00004)
- Spare nozzles

The two pumps transfer waste ~~via~~ using a valve bulge. Valves in the valve bulge allow melter feed to be routed to the associated ~~melter~~ Melter ~~feed~~ Feed ~~vessel~~ Vessel (LFP-VSL-00002/4)~~,~~ or to the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003). The vessel contents can be circulated through the pump and injected back into the ~~tank~~ vessel in the recirculation mode. In addition, melter feed can be pumped between the two ~~m~~Melter ~~f~~Feed ~~p~~Preparation ~~v~~Vessels (LFP-VSL-00002/4).

Melter Feed Vessels (LFP-VSL-00002/4)

The ~~melter~~ Melter ~~feed~~ Feed ~~vessels~~ Vessels receive blended melter feed, consisting of LAW concentrate and glass formers, from the ~~melter~~ Melter F~~f~~eed ~~p~~Preparation ~~vessels~~ Vessels (LFP-VSL-00001/3). The vessels are equipped with the following:

- Mechanical agitator
- Air displacement supply (ADS) ~~P~~pumps to transfer feed to the corresponding LAW melter
- Feed vessel ~~P~~pump
- Instrumentation for liquid level ~~and density~~ measurement
- ~~Liquid level instrument~~
- ~~Thermowell/temperature sensor for temperature measurement~~
- Miscellaneous solution addition line
- Internal spray wash ~~rings~~nozzles
- Overflow to the ~~cell sump~~C3/C5 ~~d~~Drains/~~s~~Sump ~~c~~Collection ~~v~~Vessel (RLD-VSL-00004)
- Spare nozzles

The feed vessel pump transfers waste feed through a valve bulge. Valving in the bulge allows the waste feed to be ~~routed to the corresponding melter feed preparation vessel in the event of melter shutdowns, to the same melter feed vessel to re-circulate for sampling, or to the plant wash vessel for vessel clean-out~~pumped between all four vessels: the two ~~m~~Melter ~~f~~Feed ~~p~~Preparation ~~v~~Vessels (LFP-VSL-00001/3) and the two ~~m~~Melter ~~f~~Feed ~~v~~Vessels (LFP-VSL-00002/4). Waste feed can also be transferred from the ~~m~~Melter ~~f~~Feed ~~v~~Vessels to the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003) for vessel clean-out. ~~The n~~Normally, ADS pumps transfer ~~is from the pump to~~ the melter feed from the melter feed vessel to the melter.

~~The LAW melter concentrate receipt vessels (LCP-VSL-00001/2), the LAW melter feed preparation vessels (LFP-VSL-00001/3), and LAW melter feed vessels (LFP-VSL-00002/4) will have instrumentation and interlocks to indicate or prevent the following conditions:~~

- ~~Vessel overflow~~
- ~~Loss of vessel integrity~~
- ~~Loss of agitator function~~
- ~~Agitator not operated at low liquid level to prevent agitator and vessel damage~~
- ~~High temperature, and/or Level~~

~~Controls developed to prevent or mitigate accident conditions are incorporated into the design. Operating conditions that have been identified that require interlocking with the melter feed involve individual components within the offgas system that could result in overpressurization of the melter. These operating conditions include~~~~Overpressurization could be caused by:~~

- ~~Submerged bed scrubber overflow pipe to condensate vessel blockage, resulting in submerged bed scrubber flooding.~~
- ~~Blockage of the primary film cooler and offgas line~~
- ~~Wet electrostatic precipitator flooding resulting in offgas system blockage.~~
- ~~Chilled water cooling coils in submerged bed scrubber leak, resulting in flooding of submerged bed scrubber and offgas blockage.~~
- ~~Offgas fan failure.~~
- ~~Loss of off-site power.~~
- ~~High pressure differential across HEPA filters~~

~~Regulated LAW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.F.~~

~~The glass former feed hoppers will include an interlock to prevent the transfer of blended glass formers to the LAW melter feed preparation vessel if the agitator is not operating.~~

4.1.3.2 LAW Melter Process System (LMP) ~~System~~

Figure 4A-21 presents a simplified process flow diagram of the LAW Melter process system (LMP). The purpose of the ~~purpose of the~~ LMP system ~~–is to~~is to convert a blended slurry of liquid LAW feed and glass former additives into ~~molten glass. The glass is discharged from the melter into metal containers where it cools to form the~~a durable ILAW product.

_The LAW melter system design is based on operating ~~three~~ two joule-heated ceramic melters~~,~~ ~~identified as the LMP~~ in a C3 environment. Key ~~subsystems~~ components of LMP include containment, joule heated melting, melter feed, and glass discharge.

LAW Melters (LMP-MLTR-00001/2)
The LAW ~~melters~~ Melters (Appendix 4A, Figure 4A-48) have a ~~design~~ nameplate capacity ~~range~~ of ~~approximately 10-~~15 metric tons of glass ~~per 24 hour day,~~ per melter per day. The LAW ~~melter~~ Melter has a single internal glass chamber with a rectangular surface area. The ~~melter~~ melter is powered by three sets of electrodes mounted on opposite walls of the glass pool. The glass is discharged through either of two discharge chambers located within one of the long axis walls of the ~~melter~~melter. The lid of the ~~melter~~ melter is composed of a layer of refractory backed by a corrosion-resistant metal plate and support structure. The lid also supports the components that are submerged in the melt pool and suspended in the melter plenum. The ~~melter~~ melter is encased in an integral shielding and secondary containment enclosure.

The refractory is part of the melter containment and can be described as two separate sections. These sections are the refractory in contact with the molten glass pool~~,~~ and the refractory surrounding the gas space above the glass pool, which is ~~commonly~~ referred to as the plenum. The glass pool refractory, used in conjunction with active cooling provided by a water jacket, will provide glass containment, thermal insulation, and electrical isolation. The plenum refractory is primarily designed to resist thermal breakdown, resist corrosion by offgases, and resist corrosion by splashed feed and glass.

The melter shell consists of the lid and base plate as well as the structure needed to support the lid~~,~~ and provides a gas barrier. The melter shell inner surface is designed to allow operation of the melter at a negative pressure~~ with minimal air in-leakage~~. This inner surface will also minimize the release of melter gases and contaminants in the event of melter pressurization. A small air purge will be provided for the annular space between the cooling panels and the shell to reduce the deposition of materials. This purge will be driven by melter vacuum.

The LAW melter system has been designed to shield and contain the melter so that no additional shielding or contamination control will be required for normal operations. This has been accomplished by enclosing the melter assembly in a steel box. Shielding is provided by the entire enclosure. Access panels are provided through the external shielding. When removed, these panels will allow access to the jack-bolts, electrodes, electrode thermocouples, viewing cameras, and so forth.

The heat for the LAW melter startup is provided by temporarily installed radiant electric heaters mounted on the roof of the melter. These heaters melt glass formers sufficiently to make it ionically conductive between the melter's joule heating electrodes. When a conducting path is established, the melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as *joule heating*). After some time, the melter reaches its operating temperature and slurry feeding can start. As water evaporates, the feed forms a "cold cap" on the surface of the melt. As more slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it ~~can be~~is discharged into a container.

The melter plenum is maintained at a controlled vacuum with offgas system fans and ~~controlled~~ injection of air into the offgas line near the melter exhaust. This assures containment and avoids pressurization.

Joule Heating

The joule heating system contains the melter electrodes, melter electrode power supplies, melter glass pool thermocouples, and the melter electrode control system.

The electrode configuration for each LAW ~~melter~~ Melter will consist of three pairs of plate electrodes mounted parallel to each other on the long axis of the melter. The electrodes will have forced-air cooled electrode extensions. The extensions will penetrate the side of the melter below the glass level to minimize the effects of thermal expansion and to minimize the potential for corrosion by sulfate~~ corrosion~~. Active cooling of the extensions and the use of a water-cooling jacket will prevent glass from migrating through the refractory package adjacent to the electrode extension penetrations. Power to the electrodes will be single-phase alternating current applied across opposing electrodes. The nominal glass melt pool temperature ~~range~~ is ~~950 °C to~~approximately 1,~~1~~250 °C. This is measured with thermocouples in thermowells submerged into the pool at various locations. The power to the electrodes is regulated to maintain the temperature within a selected range.

Melter Feed System

Feed will be introduced to the melter as a slurry through nozzles in the melter lid. ~~The w~~Water and ~~volatile waste feed~~ volatile constituents in the slurry ~~in the slurry~~ will evaporate, leaving behind a layer of material known as the cold cap. Waste feed components in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the molten glass. The rate of feed addition to the melter determines the cold cap coverage on the glass melt pool. The feed rate can be controlled based on the average plenum temperature measured by plenum thermocouples mounted in the melter lid. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. ~~Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the melt.~~ Air injectors will be used to mix and agitate the molten glass. ~~As the slurry is fed, molten glass is formed that accumulates in the glass tank.~~ When the melt level rises to a predetermined upper limit, an air lift mechanism is actuated and glass is discharged to a container. ~~The feed system includes the melter feed nozzles and plenum thermocouples. The melter feed nozzles are installed in the melter lid and provide a means to introduce feed slurry to the melter. The rate of feed addition to the melter determines the cold cap coverage in the melt pool, which can be controlled based on the average plenum temperature.~~

Glass Discharge System

Melter glass pool level measurement will be used to indicate when to start and stop glass discharge. It also provides alarms for high or low glass pool levels. Each LAW ~~melter~~ Melter has two identical and independently operated glass discharge systems located adjacent to each other ~~along~~ on one side of the melter. Each of these systems includes an airlift riser, a glass pour trough, a heated discharge chamber, and other components ~~or~~ and instruments needed to control the discharge of glass. When the canister is required for filling, it is taken out of the buffer rack in the Canister Handling Cave and transferred into the Pour Tunnel bogie. The bogie travels to a position under the pour spout. As the bogie moves into position under the pour spout, the pour spout glass catch tray is pushed back and signals that a canister is present. A proximity switch detects that the bogie is in position, the bogie is then locked into position, and the canister is filled with glass.

The glass discharge from the melter is initiated by injecting air or an inert gas at the bottom of the airlift riser. As the gas bubbles rise in the glass they will entrain glass in the riser, which is replaced by glass flowing in from the pool through the riser throat. The glass is lifted to the inlet of the trough, where the air bubbles disengage and the entrained glass flows into the trough. The glass then flows down the trough due to gravity and falls from the pour tip at the end of the trough into the container. The rate of glass discharge is controlled by adjusting the rate at which air is injected into the bottom of the riser.

Instrumentation, alarms, controls, and interlocks will be provided for the LMP to indicate or prevent the following conditions:

- Decrease or loss of melter plenum vacuum

~~Plenum pressurization~~

- Glass temperature too high
- Electrode extension temperature too high
- Loss of melter cooling water
- Plugged feed nozzle
- Over-filling of glass container

~~Regulated LAW vitrification plant miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.H.C.~~

4.1.3.3 LAW Melter Offgas System

The LAW melter offgas system consists of the following process systems:

- LAW ~~P~~primary ~~O~~offgas ~~P~~process sSystem (LOP) ~~System~~
- LAW ~~S~~secondary ~~O~~offgas/~~V~~vessel v~~V~~ent ~~P~~process sSystem (LVP) ~~System~~

Figure 4A-22 presents a simplified process flow diagram of the LAW primary offgas process system (LOP). The LOP is composed of tanks and miscellaneous treatment sub-systems and consists of the following:

Tanks

- Melter SBS ~~c~~Condensate ~~v~~ Vessels (LOP-VSL-00001/2)
- Pumps ~~(LOP-PMP-00001/2/3A/3B/4/5)~~
- Eductor (LOP-EDUC-00001)

Miscellaneous Treatment Sub-~~s~~Systems

- Primary and ~~s~~Secondary ~~f~~Film ~~c~~Coolers (LOP-FCLR-00001/2/3/4), one set for each melter
- Melter 1 and Melter 2 Submerged ~~b~~Bed ~~s~~Scrubbers (LOP-SCB-00001/2)
- Melter 1 and Melter 2 Wet ~~e~~Electrostatic ~~p~~Precipitators (WESP)(LOP-WESP-00001/2)

Figure 4A-23 presents a simplified process flow diagram of the LAW secondary offgas/vessel vent process system (LVP). The LVP is composed of tanks and miscellaneous treatment sub-systems and consists of the following:

Tanks

- LAW Caustic ~~c~~Collection ~~t~~Tank (LVP-TK-00001)

Miscellaneous Treatment Sub-~~s~~Systems

- Caustic Scrubber (LVP-SCB-00001~~A/1B~~)
- Electric Heaters (LVP-HTR-00001A/1B/2/3A/3B)
- ~~Thermal~~Selective Catalytic Oxidizer (LVP-SCO-00001)
- Selective Catalytic Reduction Units (LVP-SCR-00001/2~~/2~~)
- Heat Exchanger (LVP-HX-00001)
- Adsorber (LVP-ADBR-00001~~/2~~)
- HEPA Filters (LVP-HEPA-00001A/1B//2/~~2~~3A/~~2~~3B)
- Melter Offgas Exhausters (LVP-EXHR-00001A/B/C)
- LAW stack

Melter offgas is generated from the vitrification of LAW feed in ~~up to three~~the two joule-heated ceramic melters. The rate of generation of gases in the melter is dynamic. The melters generate offgas resulting from decomposition, oxidation, and vaporization of feed material. Constituents of the offgas include:

- Nitrogen oxides ~~(NO_x)~~ from decomposition of metal nitrates in the melter feed
- Chloride, fluoride, and sulfur as oxides, acid gases, and salts
- ~~Radionuclide p~~Particulates and aerosols~~Cesium and technetium as the radionuclides of significance~~
- Entrained feed material and glass

In addition, the LAW Melters generate small quantities of other volatile compounds including iodine-129, carbon-14, tritium, and volatile organic compounds. Carbon-14 and tritium are in the form of carbon dioxide and water, respectively.

The purpose of the LAW Melter offgas system is to cool and treat the melter offgas and vessel ventilation offgas to a level that is protective of human health and the environment. The offgas system must also provide a pressure confinement boundary that will control melter pressure and prevent vapor release to the cell. The design of the melter offgas system must accommodate changes in offgas flow from individual melters without causing the melter to pressurize and without allowing variations in the flow from one melter to impact the other melters.

Separate systems are provided for the initial decontamination of offgas from each melter. This is considered the primary offgas treatment system. This primary offgas system is designed to handle intermittent surges of ~~ten~~ seven times steam and three times non-condensables nominal flow from feed. The primary system consists of a Film Coolers (LOP-FCLR-00001/3), Submerged Bed Scrubbers (LOP-SCB-00001/2), and a Melter Wet Electrostatic Precipitator (LOP-WESP-00001/2). This system cools the offgas and removes particulates.

~~-To prevent pressurization of the melter and to provide more flexibility to the main offgas system, a standby line is provided with an isolation valve. In the event that the melter pressure rises above a level that could cause unplanned glass pouring, a relief valve in the standby offgas line opens allowing melter venting to the unoccupied wet process cell. Offgas from the wet process cell is drawn through HEPA Filters to remove particulates and is discharged to the atmosphere. Once the melter pressure returns to the desired set point, the valve closes.~~
~~In addition to the equipment listed above, the LAW melter offgas system contains the following vessels:~~

~~□LAW caustic scrubber blowdown vessel (V22001)~~
~~□Melter submerged bed scrubber condensate vessels (V22101, V22201, V22301)~~

~~Additionally, t~~There is ~~an extra~~ a second offgas line from the ~~melter~~ Melter to the Submerged Bed Scrubbers (LOP-SCB-00001/2) ~~is composed~~consisting of a Standby Film Cooler (LOP-FCLR-00002/4) and a butterfly valve as the isolation device. The melter is operated under negative pressure. ~~provided i~~In the ~~unlikely case~~ event that the primary offgas line plugs or ~~a~~the melter surges beyond design basis~~ occurs~~, the butterfly valve opens ~~to the standby line~~allowing offgas flow to the submerged bed scrubber through the second offgas line, thereby preventing melter pressurization.~~,~~ ~~This extra line is composed of a Standby Film Cooler (LOP-FCLR-00002/4) and a butterfly valve as the isolation device.~~ Thise line is designed to handle surges up to seven times condensable and three times noncondensable from feed without causing melter pressurization.~~- The melter is operated under negative pressure. As soon as the melter vacuum decreases pressure increases to a set point, the butterfly valve is actuated and offgas flow is allowed through the standby line to the submerged bed scrubber, thereby preventing melter pressurization.~~ In the event that the melter surge is much higher than the system is designed to handle, a pressure relief valve ~~acts as the pressure relief point~~opens venting the offgas to the wet process cell. Offgas from the wet process cell is drawn through HEPA Filters to remove particulates ~~and~~before discharged to the atmosphere. Once the melter pressure returns to the desired set point, the valve closes.

~~After the Melter Wet Electrostatic Precipitators (LOP-WESP-00001/2), the dedicated offgas lines join, plus and connect with the vessel ventilation header, and are routed to the secondary offgas treatment system. The offgas received through the vessel ventilation system consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents.~~The vessel ventilation system offgas consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents. The vessel ventilation system header joins the primary offgas system after the Wet Electrostatic Precipitators (LOP-WESP-00001/2), and the combined offgas is routed to the secondary offgas treatment system.

The secondary offgas system (from HEPA preheater to final discharge) is designed to handle maximum sustained flowrate from the ~~three~~ two melters assuming ~~the three~~ both melters are operating. The system is also capable of operating effectively if only one melter is running. The secondary offgas system consists of HEPA Filters (LVP-HEPA-00001A/1B/2A/2B) with Electric Heater (LVP-HTR-00001A/1B/3A/3B), Exhauster Fans (LVP-EXHR-00001A/B/C), mercury Adsorbers (LVP-ADBR-00001/2), a Selective Catalytic Oxidizer (LVP-SCO-00001)/Selective CatalyticReduction Units (LVP-SCR-00001/2) which houses the heat recovery unit (plate Heat Exchanger) (LVP-HX-00001), Electric ~~pre~~Heater (LVP-HTR-00002), the catalyst for volatile organic compound oxidation and the catalyst for ~~NO_x~~ nitrogen oxides reduction, and a Caustic Scrubber (LVP-SCB-00001). The following sections provide descriptions of major melter offgas treatment components.

4.1.3.3.1 LAW Primary Offgas Process System (LOP) ~~System~~

Figure 4A-22 presents a simplified process flow diagram of the LAW primary offgas process system (LOP). The purpose of the LOP tank system and miscellaneous treatment sub-systems is to cool the offgas and remove aerosols generated by the melter. The primary components consist of a film cooler, submerged bed scrubber, and a wet electrostatic precipitator.

Film Cooler (LOP-FCLR-00001/2/3/4)
The primary function of the Film Cooler miscellaneous unit sub-system is to cool the offgas and entrained molten glass droplets below the glass sticking temperature to minimize ~~solids~~ glass deposition on the offgas piping walls. The offgas exits the melter and is mixed with steam or steam/air mixture in the offgas ~~f~~Film ~~cooler~~Cooler. The Film Cooler is a double-walled pipe designed to introduce air/steam axially along the walls of the offgas pipe through a series of holes or slots in the inner wall. Each melter has a primary and secondary Film Cooler. ~~The Film Cooler is a double-walled pipe designed to introduce air/steam axially along the walls of the offgas pipe through a series of holes or slots in the inner wall.~~

~~A line connects the each Film Cooler to the its Submerged Bed Scrubber (LOP-SCB-00001/2). This line is designed to handle surges up to ten seven times condensable and three times non-condensable nominal flowfrom feed without causing melter pressurization. To prevent pressurization of the melter and to provide more flexibility to the main offgas system, a standby line is provided that is identical, except for the addition ofwith an isolation valve. In the event that the melter surge is above what the offgas system was designed to handle, a pressurepressure rises above a level that could cause unplanned glass pouring, a relief valve in the standby offgas line opens allowing melter venting to the unoccupied wet process cell. Offgas from the wet process cell is drawn through HEPA Filters to remove particulates and is discharged to the atmosphere. Once the melter pressure is backreturns to the desired set point, the valve closes.~~

Submerged Bed Scrubber (LOP-SCB-00001/2)
Each LAW M~~m~~elter has a dedicated ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber miscellaneous treatment sub-system. After each Film Cooler (LOP-FCLR-00001/3), the offgas enters the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber column for further cooling and solids removal. The Submerged Bed Scrubber is a passive device designed for aqueous scrubbing of entrained ~~radioactive~~ particulates from melter offgas, cooling and condensation of melter vapor emissions, and interim storage of condensed fluids. It will also quench the offgas to a desired discharge temperature through the use of coiling coils/jacket. The offgas leaves the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber in approximate thermal equilibrium with the scrubbing solution.

The Submerged Bed Scrubbers (LOP-SCB-00001/2) have two offgas inlets, one for the normal operations line and one for the standby line. Secondary Film Coolers (LOP-FCLR-00002/4) can be routed to either Submerged Bed ~~s~~Scrubber. The offgas enters the Submerged Bed Scrubber through the appropriate inlet pipe that runs down through the center of the bed to the packing support plate. The bed-retaining walls extend below the support plate creating a lower skirt~~,~~ to allow the formation of a gas bubble underneath the packing. The entire bed is suspended off the floor of the Submerged Bed Scrubber to allow the scrubbing solution to circulate freely through the bed. After formation of the gas bubble beneath the packing, the injected offgas then bubbles up through the packed bed. The rising gas bubbles also cause the scrubbing liquid to circulate up through the packed bed, resulting in a general recirculation of the scrubbing solution. The packing breaks larger bubbles into smaller ones to increase the gas to water contacting surface, thereby increasing particulate removal and heat transfer efficiencies. The warmed scrubbing solution then flows downward outside of the packed bed through ~~coiling~~ cooling coils/jacket.

To maintain a constant liquid level within the Submerged Bed Scrubbers (LOP-SCB-00001/2), it will be equipped with an overflow line that allows for the continuous discharge of offgas condensate and some scrubbed particulates to the Melter ~~submerged bed scrubber~~SBS Condensate Vessels (LOP-VSL-00001/2) located next to the Submerged Bed Scrubber ~~column vessel~~. The Melter ~~submerged bed scrubber~~SBS Condensate Vessels are ~~also is~~ equipped with a cooling jacket. The rate of condensate discharge is determined by how much the offgas temperature is lowered below its dew point. The condensate and some collected particulates overflow into the Melter ~~submerged bed scrubber~~SBS Condensate Vessels. To minimize the buildup of the solids in the bottom of the Submerged Bed Scrubber, condensate from the Melter ~~submerged bed scrubber~~SBS Condensate Vessels (LOP-VSL-00001/2) will be re-circulated back to the Submerged Bed Scrubber and injected through multiple lances to agitate and suspend solids on the submerged bed scrubber floor. The collected solids will then be pumped directly off the Submerged Bed Scrubber vessel floor to the Melter ~~submerged bed scrubber~~SBS Condensate Collection Vessel (RLD-VSL-0000~~3~~5). This purging and recycling process occurs simultaneously. Submerged Bed Scrubber condensate from the ~~submerged bed scrubber~~SBS Condensate Collection Vessels (LOP-VSL-00001/2) ultimately flows to the ~~PWD~~TLP system. Venting of ~~this~~ the ~~m~~Melter ~~submerged bed scrubber~~SBS ~~condensate~~ Condensate ~~vessel~~ Vessels is via the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber into the main offgas discharge pipe.

The scrubbed offgas discharges through the top of the Submerged Bed Scrubbers (LOP-SCB-00001/2) and is routed to the Melter Wet Electrostatic Precipitators (one per melter) (LOP-WESP-00001/2) for further particulate removal.

In addition to the ~~I~~instrumentation, alarms, controls, and interlocks addressed in section 4.1.3, the following will be provided for the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber to indicate or prevent the following conditions:

- High scrubber liquid~~or~~ temperature
- Low scrubber liquid level

- High condensate vessel liquid level
- Loss of chilled water supply
- Extremely high-pressure differential across the unit

~~High density~~

Melter Wet Electrostatic Precipitators (LOP-WESP-00001/2)

The Submerged Bed Scrubber (LOP-SCB-00001/2) ~~offgas~~ discharge is routed to the Melter Wet Electrostatic Precipitator miscellaneous treatment sub-system for removal of aerosols down to and including sub-micron size. Each melter system has a dedicated Melter Wet Electrostatic Precipitator (LOP-WESP-00001/2). The offgas enters ~~at the top of~~ the unit and passes through a distribution plate. The evenly distributed saturated gas then flows up ~~downward~~ through ~~the~~ tubes ~~. The tubes~~which act as positive the electrodes. Each of the tubes has a single negatively charged electrode, which runs down the center of the tube. A high voltage, direct current transformer supplies power to the electrodes. A strong electric field is generated along the electrodes giving a negative charge to the aerosols passing through the tubes. The negatively charged particles move towards the positively charged tube walls for collection. Collected particles are then washed from the tube walls along with collected mists. ~~As the gas passes through the tubes, the first particles captured are the water droplets. As the water droplets gravity drain through the electrode tubes the collected particles are washed off, and t~~The final condensate is collected in the Melter Wet Electrostatic Precipitators' (LOP-WESP-00001/2)~~wet electrostatic precipitator~~ dished bottom area. A water spray may be used periodically to facilitate washing collected aerosols from the tubes. The tube drain and wash solution are routed to the C3/C5 ~~effluent~~ Drains/Sump Collection Vessel (RLD-VSL-00004).

In addition to the ~~I~~instrumentation, alarms, controls, and interlocks addressed in section 4.1.3, the following will be provided for the Melter ~~w~~Wet ~~electrostatic~~ Electrostatic ~~precipitator~~ Precipitators to indicate or prevent the following conditions:

- Loss of electrical power to the unit
- High differential pressure across the unit
- ~~Plugging of the drain line~~Accumulation of liquid
- Loss of process water supply

Standby Offgas ~~Treatment System~~Line

The standby line consists of an offgas ~~duct~~ pipe from the melter to ~~the~~ a Submerged Bed Scrubber (LOP-SCB-00001/2), a Secondary Film Cooler (LOP-FCLR-00002/4), and ~~an isolation~~a butterfly valve as the isolation device. During a melter surge ~~(~~or potential~~ly due to the~~ offgas ~~duct being~~pipe becoming plugged~~)~~, this valve will open rapidly, providing an alternative path for the melter offgas to flow to the Submerged Bed Scrubbers (LOP-SCB-00001/2). With this alternative routing, pressure control on the melter plenum can be maintained. This standby offgas ~~duct~~ pipe will extend to the bottom of the Submerged Bed Scrubber packed bed, identical to the main offgas line. It is the same size as the main offgas line, thus providing a doubling of flow cross-section for melter-generated gases.

The LAW Melters are also equipped with a maintenance ~~ventilation~~ bypass line ~~that bypasses the submerged bed scrubber and wet electrostatic precipitator units~~allowing offgases from one melter to be routed to the other's Submerged Bed Scrubber for cooling. The gas will be processed through both a primary and secondary offgas treatment system in the same manner as the normal path. The purpose of this line is to provide melter ventilation during idling conditions in the unlikely event that ~~the~~ a Submerged Bed Scrubber (LOP-SCB-00001/2) or Melter Wet Electrostatic Precipitator (LOP-WESP-00001/2) requires maintenance. Prior to initiating use of the maintenance ~~ventilation~~ bypass line, waste feed would be secured, and the melters placed into an idle condition. No waste feed would be fed to the melters when the maintenance ~~ventilation~~ bypass line is in use.

~~The maintenance ventilation line may also find use during commissioning when the plant is running on non-radioactive, non-dangerous simulants. The maintenance ventilation line could also be used if maintenance was required for the melter standby or duty offgas lines connecting the melter and the submerged bed scrubber, or the standby offgas line actuation valve. In this case ,the standby and duty lines would be isolated, for example, by valves, spectacle flanges, or hydraulically by raising the level in the submerged bed scrubber.~~

Idling emissions from the melter are mainly heated air at ~~about 1/5th to 1/10th the~~a lower gas volume than expected during slurry feeding. The gas will ~~still~~ be processed through ~~the~~ secondary offgas treatment system that includes HEPA filtration, thermal catalytic oxidation, and selective catalytic reduction.

~~Regulated LAW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.F.~~

~~Regulated LAW vitrification plant miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.H.C.~~

~~Vessel Ventilation Offgas Treatment~~

4.1.3.3.2 LAW Secondary Offgas/Vessel Vent Process System (LVP)

Figure 4A-23 presents a simplified process flow diagram of the LAW secondary offgas/vessel vent process system (LVP). The offgas system prevents migration of waste ~~contaminates~~ contaminants into the process cells and potentially operating areas. It does this by maintaining the various LAW process vessels under a slight vacuum relative to the cell. The composition of the ventilation air is expected to be primarily air with slight ~~chemical and radioactive~~ mixed waste particulate contamination.

The vessel ventilation air is combined with the melter offgas prior to entering the secondary offgas system HEPA filter electric preheaters. The combined air streams are treated together in the remaining sections of the secondary offgas treatment systems. A pressure control valve is used to regulate the pressure between the vessel ventilation offgas system and the melter offgas system.

~~LAW Secondary Offgas/Vessel Vent Process System (LVP)~~

The melter offgas stream that is treated through the primary offgas system is combined with the vessel ventilation offgas stream and treated through the LVP tanks and miscellaneous treatment sub-systems. ~~This~~ The secondary offgas system removes the remaining particulate, mercury and miscellaneous acid gases, gaseous ~~NO_x~~nitrogen oxide compounds, carbon monoxide, and volatile organic compounds.

~~Major components in the system include:~~

- ~~HEPA preheaters and filters~~
- ~~Catalytic oxidizer and reducer unit~~
- ~~Caustic scrubber~~
- ~~LAW caustic scrubber blowdown vessel (V22001)~~

Descriptions of ~~those components~~the tanks and miscellaneous treatment sub-systems comprising the LVP are provided below:

HEPA ~~Preheaters,~~ Filters, Electric Preheaters, and Exhausters

The purpose of these HEPA ~~filters~~ Filters miscellaneous treatment sub-system (LVP-HEPA-00001A/1B/2A/2B) is to provide a final protection against dispersion of ~~radioactive~~ particulate. This helps protect the downstream equipment from ~~radioactive~~ particulate contamination. The combined offgas stream is first passed through the LAW melter offgas HEPA ~~e~~Electric ~~preheaters~~Heaters (LVP-HTR-00001A/1B/2/3A/3B). Preheating increases the gas temperature above its dew point to avoid condensation in the melter offgas HEPA ~~filters~~Filters. ~~Two Electric Heaters (LVP-HTR-00001A/B) in series, in a common housing,parallel are provided for redundancy. Both are sized to provide 100 % of the heat input, and both are normally. One is operational while the other one is on standby mode.~~ The offgas then passes through ~~circular~~ radial flow HEPA ~~f~~Ffilters. ~~To obtain 99.999% removal efficiency of the most penetrating particulates, two sets of filters with 99.97% removal efficiency are arranged in series.~~ The system is composed of two parallel trains of two filter banks each in series. The offgas passes through one train while the other remains available as an installed backup. Motive force for the ventilation is provided by the Melter Offgas Exhausters (LVP-EXHR-00001A/B/C).

Instrumentation, alarms, controls, and interlocks will be provided for the LVP system to indicate or prevent the following conditions:

- High or low differential pressure across a HEPA filter signaling to switch to the redundant unit
- Loss of ~~pre~~electric heater element

Additional information to the instrumentation, alarms, controls, and interlocks for the LVP system addressed in section 4.1.3 are described in the *LAW Vitrification Offgas Bypass Analysis*, 24590-LAW-PER-PR-03-001.

~~□Low pressure differential~~

~~□High radiation in on a sample filter on the outlet stream~~

Activated Carbon Adsorber (LVP-ADBR-0001/2)

The Activated Carbon Adsorbers (LVP-ADBR-00001/2) miscellaneous treatment sub-system removes volatile mercury, iodine, and acid gases from the offgas. The offgas flows through two internal ~~adsorbers~~activated carbon beds normally operated in series. When gasesous mercury is detected breaking through the leading ~~adsorber~~activated carbon bed, indicating that the carbon is loaded, the offgas flow is manually changed to make the trailing ~~adsorber~~bed the leading ~~adsorber~~bed. Only one ~~adsorber~~activated carbon bed is used while the loaded activated carbon is removed and replaced. The flow is then changed to make the fresh activated carbon ~~adsorber~~bed the trailing ~~adsorber~~bed.

The ~~adsorbents~~activated carbon is ~~are~~ batch loaded into the adsorber by gravity. The loaded activated carbon is batch removed by gravity and transferred by conveyor for collection in containers. A water fire suppression system may be included as a precaution against activated carbon fires, if required.

~~In addition to the I~~Instrumentation, alarms, controls, and interlocks ~~addressed in section 4.1.3, the following~~ will be provided for the Activated Carbon Adsorbers (LVP-ADBR-00001/2)~~LVP system~~ to indicate or prevent the following conditions:

- Mercury breakthrough in the leading carbon adsorber signaling to switch to the trailing carbon adsorber
- High inlet/outlet carbon monoxide concentration difference activates a water deluge fire suppression system. The offgas inlet isolation damper is automatically closed and offgas flow is automatically diverted to the other carbon ~~adsorber~~bed or to the bypass~~.~~

~~Regulated LAW vitrification miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.H.C.~~

Selective Catalytic Oxidizer~~/~~ (LVP-SCO-00001) and Selective Catalytic Reduction~~er~~ Units (LVP-SCR-00001/2)

A catalyst skid-mounted unit with a combined Selective Catalytic Oxidizer (LVP-SCO-00001) and Selective Catalytic Reduction Units (LVP-SCR-00001/2) miscellaneous treatment sub-systems will be used ~~T~~to remove ~~products of incomplete combustion,~~ volatile organics compounds, carbon monoxide, and ~~NO_x~~ nitrogen oxides ~~in~~ from the offgas stream~~, a catalyst skid mounted unit with a combined Selective Catalytic Oxidizer (LVP-SCO-00001)unit and a~~

~~NO$_x$ Selective Catalytic Reduction Units (LVP-SCR-00001/2) will be used.~~ ~~In this these miscellaneous unittreatment sub-systems, organic compounds and carbon monoxide are oxidized to carbon dioxide, and water vapor, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream). Also, NO$_x$ nitrogen oxide is reacted with reduced by ammonia to reduce it to nitrogen gas and water vapor.~~

The offgas is first treated in the ~~volatile organic compound catalyst column~~Selective Catalytic Oxidizer (LVP-SCO-00001) where organic compounds and carbon monoxide are oxidized to carbon dioxide and water vapor. These reactions are exothermic. The Selective Catalytic Oxidizer (LVP-SCO-00001) operates at a temperature low enough to prevent the formation of additional nitrogen oxides.
~~operates at a somewhat lower temperature than the NO$_x$ catalystSelective Catalytic Reduction Units (LVP-SCR-00001/2); therefore, it is placed at the beginning of the unitcatalyst skid. This arrangement also prevents the formation of NO$_x$ nitrogen oxides through the volatile organic compound catalystSepectiveSelective Catalytic Oxidizer (LVP-SCO-00001) from the oxidation of ammonia, which is added after the gas goes passes through the volatile organic compound catalystit. Further offgas heating occurs through the volatile organic compounds catalyst, as the reactions occurring are exothermic.~~

After the (LVP-SCO-00001), t~~As the~~ offgas is ~~enters the unitSelective Catalytic Oxidizer (LVP-SCO-00001), it the gas travels through~~heated through a ~~the heat recovery unit, which is a~~ plate heat exchanger and an electric heater to bring the offgas up to the operational temperature of the Selective Catalytic Reduction Units (LVP-SCR-00001/2).~~. The heating medium used is the exhaust from the selective catalytic oxidizer/reducerreduction unit. The cool offgas enters the cold side of the heat recovery unit, then passes through an electric heater to bring the temperature up to that required for the volatile organic compound catalystSelective Catalytic Oxidizer (LVP-SCO-00001) to operate.~~

~~After the volatile organic compound catalystSelective Catalytic Oxidizer, t~~The heated offgas enters ~~a chamber~~the Selective Catalytic Reduction Units (LVP-SCR-00001/2) ~~Selective Catalytic Reduction Units (LVP-SCR-00001/2),~~ where ~~a gas mixture of~~ ammonia~~, CO$_2$, and water vapor~~ is injected through an atomized spray and allowed to mix with the offgas. The nitrogen oxides are reduced by the ~~Ammonia~~ ammonia ~~is added so that the NO$_x$ nitrogen oxides reduction reactions can be carried out~~to nitrogen gas and water. Two sets of ~~NO$_x$ catalyst modules~~Selective ~~Xatalytic~~Catalytic Re~~E~~eduction Units (LVP-SCR-00001/2) are ~~required to achieve the required removal efficiency of greater than 98%~~arranged in series. The offgas is treated through the first ~~set of NO$_x$ catalyst modules~~the Selective Catalytic Reduction Units (LVP-SCR-00001). After the first ~~modules~~Selective ~~c~~Catalytic ~~r~~Reduction ~~unit~~Unit, more ammonia is injected into the ~~stream~~ offgas to allow further conversion in the second Selective Catalytic Reduction Unit (LVP-SCR-00002)~~set. The offgas then goes through the second catalyst module. Reduction of NO$_x$ nitrogen oxides is also an exothermic reaction; therefore, it significantly increases the offgas temperature.~~ The reduction reaction is also exothermic, significantly increasing the offgas temperature. ~~This~~ The hot offgas ~~then enters the hot side of~~is the heating media for the ~~the~~ heat ~~recovery~~ exchanger, ~~unit to heat the incoming offgas~~discussed above, cooling the offgas. The cooled offgas stream is then directed to the Caustic Scrubber for ~~iodine removal,~~ acid gas removal~~,~~ and final cooling.

Instrumentation, alarms, controls, and interlocks will be provided for the Selective Catalytic Oxidizer ~~catalytic oxidizer~~/ Selective Catalytic Reduction Units~~reducer unit~~ to indicate or prevent the following conditions:

- High- differential pressure ~~differential~~ across each catalyst bed
- Loss of ammonia gas ~~mixture~~ supply to the ~~NO_x~~ nitrogen oxides selective catalytic reduction ~~column~~unit
- Failure of the electric heater
- Ammonia analyzer to ~~provide amount of~~indicate ammonia slip in the outlet.
- Low offgas temperature entering the unit
- High temperature differential across the unit
- High ~~NO_x~~ nitrogen oxides concentration in the unit outlet stream
- High volatile organic compound concentration in the unit outlet stream

Caustic Scrubber (LVP-SCB-00001)

The LAW Melters' offgas Caustic Scrubber miscellaneous treatment sub-system further treats the offgas by removing iodine and acid gases and providing final offgas cooling. ~~Some of the process-generated sulfur oxides are also removed in this scrubber.~~ The offgas stream enters the bottom of the scrubber and flows upward through a packed bed. Contaminantes in the offgas stream are absorbed into the liquid stream through interaction of the gas, liquid, and packing media. To neutralize the collected acid gases, a sodium hydroxide solution is added periodically to the LAW Caustic Collection ~~vessel~~Tank (LVP-TK-00001). The clean offgas is then discharged through an internal mist eliminator to prevent droplet carryover. The scrubbing liquid flows downward through the packing bed and drains into the LAW Caustic Collection ~~vessel~~Tank (LVP-TK-00001). This tank is periodically purged to the pretreatment plant. After passing through the Caustic Scrubber (LVP-SCB-00001), the offgas is released to the environment via a flue in the ~~facility~~plant stack.

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.3, the following will be provided for the Caustic Scrubber to indicate or prevent the following conditions:

- Loss of recirculation pump ~~indicating to switch to redundant unit~~
- Loss of caustic supply
- Loss of process water supply
- High- differential pressure ~~differential~~ across the column
- Low scrubbing liquid level
- High scrubbing liquid level

- Loss of transfer pump
- Low pH
- High specific gravity (density)

~~Regulated LAW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.F.~~

~~Regulated LAW vitrification miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.H.C.~~

4.1.3.4 Radioactive and Non-~~R~~radioactive Liquid Waste Disposal Systems (RLD and NLD) ~~Systems~~

DWP Attachment 51, Appendix 9.1 contains a process flow diagram of the radioactive and nonradioactive liquid waste disposal system (RLD and NLD) (24590-LAW-M5-V17T-P0014). The RLD receives LAW vitrification process effluents for storage and transfer.

The RLD tank system consists of three main vessels:

- ~~Plant wash vessel~~Plant Wash Vessel (~~V25001~~RLD-VSL-00003)
- ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel ~~(V25002~~RLD-VSL-00004)
- ~~Submerged bed scrubber~~SBS ~~condensate~~ Condensate ~~collection~~ Collection ~~vessel~~ Vessel (~~V25003~~RLD-VSL-00005)

The ~~submerged bed scrubber~~SBS Condensate Collection Vessel (RLD-VSL-00005) and the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003) are located in the LAW effluent cell. The ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel (RLD-VSL-00004) is located below grade to provide fire protection water collection and to collect effluents from the wet electrostatic precipitator, a gravity floor drain system, and a pumped sump system.

Sources of effluents into the RLD system are production and non-production-~~-~~related activities. Production effluents are ~~radioactive~~ mixed waste liquids or slurries routinely or periodically generated by the waste treatment process. These effluents are routed directly or indirectly to the ~~submerged bed scrubber~~SBS Condensate Collection Vessel (RLD-VSL-00005). Liquid effluent from non-production activities, such as vessel, equipment and cell/cave washes, and sump discharges, are routed to one of the three vessels, depending on the nature of the effluent. Dangerous or ~~radioactive~~ mixed waste is routed to either the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003) or the ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel (RLD-VSL-00004). Liquid that is ~~not~~ non-dangerous/non-~~-~~radioactive is routed to the C1/C2 Floor Drain/Sump Collection Tank in the NLD system.

The functional purpose of the RLD system is to receive effluents for interim storage~~,~~ and to transfer the effluent to the pretreatment plant ~~or BOF facilitiesas appropriate~~. In addition, mixing and sampling of the effluent may be performed in this system as required.

~~Plant Wash Vessel~~Plant Wash Vessel (RLD-VSL-00003)

This vessel is designed to ~~handle the largest capacity~~receive the total volume of either the largest vessel in the LAW vitrification plant or the largest volume from the vessel/equipment wash or drain in the LAW vitrification plant. The largest volume is from the SBS~~submerged bed scrubber~~ Condensate Collection Vessel (RLD-VSL-00005). Effluent sources for the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003) are vessel washes and the overflow from the ~~submerged bed scrubber~~SBS Condensate Collection Vessel (RLD-VSL-00005). The vessel is fitted with level ~~and temperature~~ instrumentation. The vessel is vented into a common vessel ventilation header that drains into the ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel (RLD-VSL-00004). During normal operation, the effluent characterized in the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003) is expected to be transferred to the ~~PWD~~pretreatment plant.

~~LAW~~ C3/C5 ~~Effluent~~ Drains/Sump Collection Vessel (RLD-VSL-00004)

This vessel ~~and the bermed area around the vessel are~~is designed ~~for~~ to contain the ~~probable~~ maximum amount of fire protection water ~~as well as hold~~and the volume equivalent to the largest C3/C5 floor area wash. The ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel (RLD-VSL-00004) routinely collects liquid drained from the Melter Wet Electrostatic Precipitators (LOP-WESP-00001/2)~~. This vessel is designed for a two day hold-up of the wet electrostatic precipitators effluent with three melters operating under expected operating conditions~~. The overflow from the Melter Concentrate Receipt Vessels (~~V21001, V21002, V21003~~LCP-VSL-00001/2) is also routed to ~~this vessel~~the C3/C5 Drains/Sump Collection Vessel.

The C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004) is fitted with level~~, density, and temperature~~ instrumentation. The ~~vessel (LAW~~ C3/C5 ~~Effluent~~ Drains/Sump Collection Vessel~~)~~ is vented into a common vessel ventilation header. Condensate that forms in the header drains into the ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel. Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. Routine process-related effluent from ~~wet~~ Wet ~~electrostatic~~ Electrostatic ~~precipitator~~ Precipitator drains will be pumped from this vessel to the ~~submerged bed scrubber~~SBS Condensate Collection Vessel, as necessary. Effluent generated from other sources will be pumped to the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003) until it reaches a predetermined level to maintain adequate capacity for fire protection water. The ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel is located in an enclosed C3/C5 cell area. The ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump ~~Sollection~~Collection Vessel overflows to a sump in the same cell. During normal operation, the effluent characterized in the ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel is expected to be transferred to the ~~PWD~~ TLP system via the SBS~~submerged bed scrubber~~ Condensate Collection Vessel (RLD-VSL-00005).

SBS~~Submerged Bed Scrubber~~ Condensate Collection Vessel (RLD-VSL-00005)

This vessel is designed to store ~~submerged bed scrubber~~SBS column purge effluent. The SBS~~submerged bed scrubber~~ Condensate Collection Vessel (RLD-VSL-00005) routinely receives effluent from the Submerged Bed Scrubber ~~column vessels~~(LOP-SCB-00001/2) and the

~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection Vessel (RLD-VSL-00004)~~. It can also receive transfers from the submerged bed scrubber condensate vessels~~.

The SBS Condensate Collection Vessel is fitted with level ~~and temperature~~ instrumentation~~. The vessel~~ and is vented into a common vessel ventilation header that drains into the ~~LAW~~ C3/C5 ~~effluent~~ Drains/Sump Collection ~~vessel~~Vessel (RLD-VSL-00004). Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. The SBS~~submerged bed scrubber~~ Condensate Collection Vessel overflows to the ~~plant wash vessel~~Plant Wash Vessel (RLD-VSL-00003). During normal operation, the effluent characterized in the ~~submerged bed scrubber~~SBS ~~condensate~~ Condensate ~~collection~~ Collection ~~vessel~~ Vessel is expected to be transferred to the ~~PWD~~TLP system.

~~The control system alarms at two different high level setpoints. Upon reaching high level setpoint, the control system initiates a high alarm and alerts the operator. Upon reaching high high level setpoint, the control system initiates a critical alarm and alerts the operator.~~

~~Regulated LAW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.F.~~
~~Instrumentation, alarms, controls, and interlocks will be provided for the RLD to indicate or prevent the following conditions:~~

- ~~Level indication: Level in the vessel is monitored for process condition and status. High high liquid level will result in an interlock trip that will stop the incoming transfer (shuts off pump or shuts valves). High level alarm alerts operators to a high fill condition and after a set period time may result in an interlock trip. Low level alarm alerts operator to low fill condition. Low low level will result in the stop of outgoing transfer.~~
- ~~Temperature indication: Temperature in the vessel is monitored for process condition and status.~~

~~Additional information on the RLD tank system is provided in the following documents located in Attachment 51, Appendix 9:~~

~~*Flooding Volume for the LAW Facility*, 24590-LAW-PER-M-02-002~~

~~*LAW Facility Sump Data*, 24590-LAW-PER-M-02-001~~

~~*System Logic Description for the Low Activity Waste Facility - Radioactive Liquid Waste (RLD) System*, 24590-LAW-PER-J-02-001~~

4.1.3.5 Radioactive Solid Waste Handling System (RWH) ~~System~~

The primary functions of this system will be to provide ~~methods and packaging~~equipment for the change-out of LAW ~~melter~~ process vessels and other miscellaneous mixed wastes. This system provides the equipment to move waste out of the building.

The vessels are designed for 40 years of service. However, ~~I~~in the event of a failure, the ~~out-of-service melter~~ process vessel will be prepared for export by rinsing, disconnection of the process lines, and decontamination. The vessel will be lifted out of the process cell and covered~~,~~ to prevent a spread of contamination. The vessel will be placed in an approved ~~overpack container~~package staged for vessel receipt. Once closed and secured, the ~~overpack~~package, containing the vessel, will be delivered to ~~the central waste storage area~~an appropriate TSD facility. A similar process in reverse will be used for the introduction and installation of new LAW ~~melter~~ process vessels.

It is anticipated that LAW ~~m~~Melters will require replacement at some point. When the end of a melter's operational life is reached, residual molten glass will be removed as immobilized product, as much as is practical. The LAW Melter~~melter~~ will be allowed to cool and then will be disconnected. The steel box in which the melter is enclosed will be sealed, decontaminated if required, and transported to an appropriate TSD facility.

Disposal of miscellaneous mixed waste streams created during operation will be ~~accomplished~~ done by packaging at the point of generation. Localized collection points and disposal routes will be established at logical and optimal locations to accommodate maintenance and operations. Waste containers will be transferred to a staging areas where packages will be weighed, ~~placarded~~labeled, and decontaminated for non-fixed contamination, if needed, prior to export. The packaged waste forms will then be ~~transferred to the central waste storage area~~stored at the WTP until final disposition.

4.1.3.6 ILAW Glass Container Handling

The ILAW glass container handling activities will consist of the following systems:

- LAW container receipt handling system (LRH) ~~system~~
- LAW container pour handling system (LPH) ~~system~~
- LAW container finishing handling system (LFH) ~~system~~
- LAW container export handling system (LEH) ~~system~~

The individual systems and their primary functions are described below:

LAW Container Receipt Handling System (LRH) ~~System~~
The LRH system takes delivery of new ILAW containers and provides a means to transfer ~~those~~ these empty containers to the LPH transfer bogie (wheeled cart for ~~equipment and~~ container transfer).

Container Receipt
After removal of the shipping overwrap and initial receiving inspection, the containers are placed on a conveyor system and transferred into the ~~facility~~plant as needed. New containers are then logged into the tracking system.

Container Import

Prior to the need for additional containers, a final inspection and transfer takes place in the container import bay. Each new container is moved to a container inspection stand. This allows an operator to assess the upper head/lifting flange area, including the "fill" opening, and to observe the inside of the container with a light.

The rest of the container is inspected as required, then the container is placed on the import line 1 or 2 staging conveyer, and the tracking log is updated. If the container inspection fails, it is logged~~/~~ and tagged appropriately and set aside~~ until it can be surveyed out of the area~~.

Each time a container is placed on the conveyor, an operator initiates a conveyor transfer. The transfer serves to index containers on the staging conveyor forward so there is always a container in the "pickup" position on the airlock conveyor.

Container import instrumentation, alarms, controls, and/or interlocks will be provided as follows:

- The ~~three trap doors~~hatches are interlocked with the ~~storage cranes~~hoist and bogies so ~~that~~ the ~~trap doors~~hatch cannot be opened unless a process crane is positioned above the ~~trap door~~hatch. Conversely, the process cranes cannot leave ~~trap door~~hatch positions unless the ~~trap door~~hatch is closed and locked.
- The ~~trap doors~~hatches are ~~also~~ interlocked with the bogies so that the ~~doors~~ hatches can not open unless a bogie is positioned below the ~~trap door~~hatch. The interlock prevents the bogie from leaving the ~~trap door~~hatch position unless the ~~trap door~~hatch is closed.
- ~~The storage cranes are interlocked with the hoists so that the cranes can only move with the grapple at transport height.~~
- ~~The storage cranes are interlocked so that their hoists can only be lowered when signal confirms door is in open position.~~
- ~~The storage cranes are interlocked to prevent them from colliding.~~

LAW Container Pour Handling System (LPH)~~ System~~

Each of the ~~three~~ LAW melters has two glass discharges that operate independently. Each melter discharge chamber is ~~provided~~ aligned with a glass pour ~~cell~~ cave under the melter cell ~~and~~ with associated features for filling a container with glass. ~~The melter will alternate filling containers in each pour cell. After a container is filled in one pour cell the melter will begin filling the next container in the other pour cell, although containers can be filled in the same pour cell. Each pour cell is physically isolated from the others for maintenance access~~Containers can be filled using one pour cave, using alternating caves, or both caves at the same time using alternating lifts. The LPH system handles and positions product containers for filling with LAW glass product. The major pieces of equipment include the container turntable, container elevator, transfer bogies, and monorail hoists.

Container Turntable, Container Elevator, Glass Pour Seal Head

A container turntable is provided in each pour ~~cell~~ cave for handling containers. The turntable accommodates three containers and rotates to position them at three stations: the container

~~import/export~~transfer station, the container fill station, and the container cooling station. At each container location in the turntable is a lower overpack section that locates the containers and provides support. Containers remain in the overpack during the elevating and glass filling cycle.

As containers are filled and cooled, the turntable rotates to the ~~import/export~~transfer station where container changeout occurs. Cooled, full product containers are removed from the turntable and replaced with empty containers. ~~Once the empty container's lid has been removed, t~~The turntable is rotated to position the empty container at the fill station. The container elevator raises the empty container and lower overpack up to the glass pour seal head for container filling~~. At the upper position a lock bolt is engaged to ensure elevator position during the container fill cycles~~.

The elevator is equipped with features to provide a weight of the product container being supported. Weight is used to verify that a container is present and that it is ~~not full of glass~~empty. The weight must be between established minimum and maximum values for glass pouring to occur. Additionally, the weight can be used to ensure that container filling is occurring and to provide the rate of glass pouring. The elevator weight is not intended to give an accurate weight of the container; it is merely used as an indication of container presence and condition.

The glass pour seal head is the interface between the melter discharge and the product container during glass pouring. The seal head consists of a metal bellows arrangement that is connected to the melter discharge~~,~~ with the other end of the bellows open for ~~connection to~~interface with product containers.

Container fill level is monitored by a thermal imaging camera. The camera provides a ~~complete~~ view of the diameter ~~of~~ and the upper ~~two-thirds~~one-half of a container. The thermal imaging camera indicates ~~canister~~ container fill level for primary control of fill rate and pour shut off. In the event of primary level detection failure, a gamma detector activates a high-high level shutdown.

The container is filled using several pours. The pour process occurs more quickly than glass can be made in the melter, resulting in lag time between pours. Rapid pouring allows molten glass to flow out to all edges of the container. Following the final glass pour batch, the container remains in position to provide initial container cooling and containment of final glass discharges. The ~~elevator lock is then retracted and the~~ container is then lowered to the turntable. The turntable is again rotated, placing the recently filled container at the cooling/venting station. Container cooling continues while another container undergoes the fill cycle. Once cooled, the container is rotated ~~back~~ to the ~~import/export~~transfer position for export ~~station~~ and the process is repeated.

Container Transportation

~~The~~ Another function of the LPH system is to provide product container transportation between the container transfer bogie and the ~~melter~~ pour cave turntable. The system transfers empty product containers from the container transfer bogie to the melter turntable, and transfers full product containers from the turntable to the transfer bogie in a manner that supports the plant throughput goals.

Concrete walls separate the pour caves from the bogie transfer tunnel. These walls have doorways large enough to allow the hoist units loaded with new or filled product containers to pass through them. The doorways are fitted with steel shield doors.

Concrete walls also separate the monorail maintenance facility from the bogie transfer tunnel. These walls have ~~passages large enough to allow the hoist units, loaded with spare parts, to pass through them~~openings sized to prevent an ILAW container from entering the maintenance area. These doorways are also fitted with steel shield doors that provide radiological shielding from sources in the ~~drum~~ transfer tunnel during hands-on maintenance activities in the monorail maintenance facility.

Pour cave transfer operations are conducted remotely~~,~~ with only a few exceptions. Maintenance~~/~~ and recovery operations in the bogie transfer tunnel, such as a jammed grapple, may require hands-on intervention. Monorail hoist maintenance operations conducted in the maintenance facility are completely hands-on. Monorail hoist recovery operations can become a hands-on/ remote combination depending on the failure details.

The LPH system provides a buffer storage area for ILAW containers in the event ~~down stream~~ downstream processing lines become backed up. Additionally, ILAW container rework ~~that cannot be managed locally~~ is conducted in the buffer storage area. Anticipated activities include ILAW container transfers into the buffer storage area from the container transfer bogies, container transfers within the buffer storage area, container transfer from the buffer storage area to the transfer tunnel, and container rework. The buffer storage area is adjacent to a crane maintenance facility. The crane maintenance area is shielded from the buffer storage area ~~is shielded~~ to allow hands-on maintenance in the crane maintenance facility and ~~drum~~ transfer tunnel while containers are present in the buffer storage area.

The LPH ~~drum~~ transfer tunnel runs ~~all the way to~~from the bogie maintenance area on the west end of the ~~facility~~plant to the buffer storage area at the east -end of the building. The buffer storage area import/export positions are located within the container transfer corridor. Concrete walls with passages for ILAW containers separate the north and south buffer storage areas and the container transfer corridor. The passages are equipped with manually operated steel shield doors to support maintenance or bogie recovery operations that might be required in this portion of the transfer tunnel. The LFH hoists operating in the lidding area above this section of the container transfer corridor transfer ILAW containers to and from the buffer storage area import/ export position.

Buffer storage area container transfer operations are conducted with the use of a ~~10-ton~~ bridge crane. The crane ~~runways~~ rails begin in the crane maintenance facility adjacent to the north end of the buffer storage area and extends south. The runway~~s~~ provides crane coverage to the crane maintenance area, the ILAW container buffer storage area, the container transfer corridor, and the two container import/export positions. There are container storage positions in the north

~~portion of the store, a minimum of five container storage positions in the~~and south portions of the store, and one rework position~~,~~ also in the south portion of the store. The rework position is located in the southeast corner of the ILAW container buffer storage area/rework area. The rework position can be fitted with a powered turntable, a pair of master-slave manipulators~~, and a~~. A shielded window is located in this area. Directly east of the rework position, on the cold side of the buffer storage area, is a rework area operating platform that provides operator access to the master-slave manipulators and shielded window.

A ~~crane suspended from the maintenance facility ceiling is used~~winch is provided to support maintenance operations on the buffer storage area bridge crane. A steel shield door~~, along with a concrete wall rising from the floor~~ and a concrete wall separate the crane maintenance facility from the buffer storage area~~. They~~, allowing maintenance operations to be conducted while the buffer storage area contains full ILAW containers.

LAW Container Finishing Handling System (LFH)~~ System~~

Figure 4A-24 presents a simplified process flow diagram of the LAW container finishing handling system (LFH). There are two LFH finishing lines. The functions of the LFH system are to verify the ~~glass volume~~container fill level, determine if inert fill is required, complete closure of the ILAW container, decontaminate the exterior of the container, and ~~to~~ verify surface contamination levels before exporting the container~~ into the container storage area~~. The system also has the ability to sample the solidified glass, places the glass shards in a vial, and ~~passes~~ make these vials available for transfer to the laboratory.

The filled containers are raised from the transfer tunnel into one of two finishing lines and placed on a bogie. The bogie with the container travels to the shard sampling station. A sample of the glass ~~is~~ may be taken with the glass shard sampler. Based on the ~~calculated volume~~measured level in the container, inert fill is added as needed. From there the bogie travels to the container ~~weld~~ lidding station where the lid is mechanically secured to the container. ~~Upon completion of container welding~~After mechanically sealing the lid to the container, the bogie travels to the decontamination area.

~~There are two separate decontamination areas that perform the same function. T~~At the decontamination station, the container is ~~then electrically grounded and~~ decontaminated with ~~CO_2~~ carbon dioxide pellets. ~~Produced~~ Debris produced during decontamination is collected with a HEPA filtered exhaust system. This gas stream is then routed to the ~~facility~~plant vent system where it is passed through the ~~facility~~plant's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported to the swabbing station where it is surveyed for loose surface contamination to verify it meets the contamination requirements. The swabbing machine uses a power manipulator to maneuver the ~~cotton~~ swabs over the surface. The contaminated swabs are then monitored to determine gamma-beta ~~and alpha~~ levels for smearable contaminates. If contamination levels exceed C2 contamination criteria, the container can go through the ~~CO_2~~ carbon dioxide decontamination station~~ or be transported into the fixative station where fixative is sprayed over the entire surface of the container and after curing~~

~~the container is resurveyed~~. If the container meets C2 contamination criteria, the bogie moves into the monitoring/export station. As the container is transported into the monitoring/export station from the swabbing station, gamma monitoring measures the surface dose rate of the decontaminated container. If the container exceeds the contamination requirement, it is classified as an out-of-specification container. Otherwise, the dose rate is measured and is recorded with the container's records. Out-of-specification ILAW containers are routed back through the decontamination ~~and fixative~~ stations until the radiological contamination levels are within specification. The container is then exported ~~to the product container storage and export~~for shipment to the disposal site.

Instrumentation, alarms, controls, and interlocks will be provided for the LRH system to indicate or prevent the following conditions:

- Opening of personnel access door when container is present in the line transfer station
- Opening of personnel access door when either line transfer trap doors are open
- Opening of both line transfer trap doors at the same time
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the line transfer station

Decontamination Station

~~The two~~A decontamination stations ~~are~~ is located within each of the finishing lines in the LAW vitrification plant~~vitrification plant~~~~facility~~. After the ILAW container has been ~~cooled and~~ sealed, it is transported to the ~~CO_2 blasting~~ decontamination station~~. The container is electrically grounded during blasting operation due to static electricity generated during CO_2 blasting~~. Equipment items located in the decontamination station include the ~~CO_2~~ carbon dioxide decontamination ~~gun~~manipulator, turntable, and exhaust system~~, and tracking system~~. Most other items are located outside of the ~~hot~~ decontamination station~~cell~~, including the ~~CO_2~~ carbon dioxide pelletizer, the transport air compressor, and the liquid carbon dioxide~~CO_2~~ storage and delivery system, exhaust fans, and HEPA filters.

The containers are decontaminated ~~with~~ using carbon dioxide~~CO_2~~ pellets. The carbon dioxide~~CO_2~~ ~~blasting~~ decontamination ~~gun contains~~manipulator is fitted with an exhaust recovery hood to recover the effluent from the decontamination ~~cleaning~~ operation. Debris produced during decontamination is collected with a HEPA filtered exhaust system. This gas stream is then routed to the ~~facility~~plant vent system where it is passed through the ~~facility~~plant's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported from the decontamination station to the swabbing station.

Instrumentation, alarms, controls, and interlocks will be provided for the decontamination station to indicate or prevent the following conditions:

- Opening of ~~welding/~~the decontamination or decontamination/swabbing containment door during decontamination
- Opening of ~~welding/~~the decontamination and decontamination/swabbing containment door at the same time

Swabbing and Swabbing-Monitoring Station

At the swabbing station, containers are surveyed for loose surface contamination to verify that they meet the contamination requirement. The swabbing machine ~~uses a manipulator to~~ maneuvers the swabs over the container surface. After a prescribed area is covered, the contaminated swabs are exported away from radioactive source for monitoring to determine gamma-beta ~~and alpha~~ levels for smearable contaminates. If contamination levels exceed C2 criteria, the container is transported back into the decontamination station for rework. ~~If contamination levels are still above C2 criteria, the container is transported into the fixative station, located above the swabbing station.~~ If the container meets C2 criteria, the turntable bogie moves into the ~~monitoring/~~export station.

Once the container is transported into the monitoring/export station from the swabbing station, a gamma monitor~~ing~~ measures the ~~surface~~ dose rate of the decontaminated container. If the container exceeds the specified dose requirement, it is classified as an out-of-specification container; otherwise, the dose rate is measured and is recorded within the container's records. The container is then exported out of the ~~decontamination area into product container storage and export~~monitoring/export station for shipment to the disposal site.

Instrumentation, alarms, controls, and interlocks will be provided for the swab monitoring station to indicate or prevent the following conditions:

- Personnel access when a container is present in swab monitoring station
- Opening of decontamination/swabbing or swabbing/export containment door during swabbing
- Opening of personnel access door when container is present in the swabbing station
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the decontamination area
- Opening of personnel access door if high concentration of carbon dioxide is present within the decontamination area
- Rotation of posting turntable during swabbing
- Export of swab if radiation levels from swab are higher than design radiation classification in the operational area

~~Container Fixative Station~~

~~After CO_2 carbon dioxide decontamination, if contamination levels are still above C2 criteria, the container may be transported into the fixative station, through the fixative hatch using the fixative crane. The container is placed onto the cooling/drying stand where The container is~~

~~allowed to cool to the desired temperature, if required. The fixative crane transports the container into the fixative booth and the fixative nozzle sprays a fixative over the entire container surface. After curing, the container is lowered back into the swabbing station.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the fixative unit to indicate or prevent the following conditions:~~

- ~~Opening of the fixative booth containment door, if required, during the fixative process.~~
- ~~Start of system when the fixative booth containment door is open, if required.~~
- ~~Start of system when personnel are present within the fixative booth.~~
- ~~Start of system if ventilation system fails. If ventilation fails during the fixative process, fixative system automatically shuts down.~~

~~Container Monitoring/Export Station~~
~~Before final export to the storage area, each container received from the swabbing station is measured for surface dose rate levels. A gamma scan array is used to measure dose rate from the container. The operator will verify the process, then record the reading. If the container fails to meet the surface dose rate requirements, the container is labeled as an out-of-specification container. The container is finally exported to the product container storage and export area.~~

~~Container monitoring/export station instrumentation, alarms, controls, and/or interlocks will be provided to indicate and/or prevent the following conditions:~~

- ~~Opening of the personnel access door when storage trap door is open~~
- ~~Opening of the storage trap door when personnel are present within the export station~~

LAW Container Export Handling System (LEH) ~~System~~
The purpose of the LEH system is to ~~store~~ load ILAW containers ~~prior to transferring to a Hanford Site TSD unit. This system is composed of a storage facility, export/swabbing area, truck bay, and two separate crane maintenance areas. The ILAW containers are stored in the large structure. Loading of containers~~ onto a transportation ~~trucks~~vehicle ~~occurs in the export high bay area. Containers are swabbed and loaded into transportation flasks~~for transfer to a Hanford Site TSD unit. This system is contained in a truck bay on the east end of the LAW vitrification ~~facility~~plant.

Under normal operations~~,~~ ~~an~~ the ILAW container will be received from the LFH system ~~,~~ through a ~~trap door~~hatch. ~~The ILAW container contamination and radiation dose limits are verified to be within specifications. An operator records the container's identification and position as it is placed into the storage array~~Radiological dose rate and contamination level are determined and verified to be within limits prior to entering the LEH system. An overhead crane lifts the ILAW container through the hatch and places it on the transportation vehicle.

~~The impact of temperature, shielding, and environmental conditions were considered in the design of the storage plant and equipment within the plant, in terms of corrosion, degradation,~~

~~and accessibility to equipment. The crane area is provided with closed circuit TV cameras for in plant surveillance. A lighting system with fixtures provides the required illumination. Since personnel are excluded from entry due to radiological dose rates, remote access to each container is provided overhead~~Operations are remote and maintenance is "hands-on" in the LEH system. The overhead crane is provided with closed circuit ~~TV~~television cameras for operation when radiological conditions do not permit personnel access during the ILAW container loading.

4.1.3.7 LAW Melter Equipment Support Handling System (LSH) ~~System~~

The primary function of the LSH system is to provide the equipment and support necessary to complete maintenance tasks on all melters and equipment in the melter gallery of the LAW vitrification ~~vitrification plant~~~~facility~~plant. The primary equipment used in support of the maintenance efforts are:

- Consumable change-out boxes
- Consumable change-out boxes storage racks
- Consumable change-out boxes preparation stand
- Melter gallery process cranes
- Consumable change-out boxes handler
- Lifting head
- Melter gamma gate
- Shield cover removal tool

Melter consumables will be removed through the top of the melter shielding. Melter consumable items will be those that require routine and non-routine maintenance, but provide necessary functions to continue melter operations. The routine consumable items will be bubbler assemblies. New bubbler assemblies will be shipped to the ~~facility~~plant and will be installed into the melter. Spent bubblers will be extracted from the melter~~, cut up,~~ and packaged into a ~~drum~~ box for disposal.

Refractory thermocouples, airlifts, level detectors, feed nozzles, and film coolers will be considered non-routine and are replaced on an as-needed basis according to the appropriate procedures and with appropriate equipment.

~~The LSH also provides the methods, equipment, and packaging for the import of new melter bubbler assemblies and export of spent melter bubbler assemblies as well as removal of melter consumables.~~

4.1.3.8 LAW Vitrification Plant Ventilation

The LAW vitrification plant will be divided into four numbered zones (the C4 designation is not used) listed and defined below, with the higher number indicating greater radiological hazard potential and therefore a requirement for a greater degree of control or restriction. The zoning of the ventilation system will be based on the classifications assigned to building areas for potential radiological contamination. Zones classified as C5 are potentially the most contaminated and include the pour caves, buffer storage area, and process cells. Zones classified as C1 are uncontaminated areas.

Containment will be achieved by maintaining C5 areas at the greatest negative pressure, with airflows cascaded through engineered routes from C2 areas to C3 areas and on to the C5 areas. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and hence the amount of air requiring treatment. Adherence to this concept in the design and operation of the LAW vitrification plant will ensure that the ventilation air does not become a significant source of exposure to operators, and that the air emissions do not endanger human health or the environment.

An ~~effluent~~ exhaust air radiation monitoring system, consisting of sensors to monitor radiation in the exhaust air~~effluent~~ stream, or a representative sampling system is provided in the discharge header downstream of the exhaust fans. A monitoring system would consist of probe assemblies, vacuum pumps, a stack flow sensor, temperature sensor, and radiation sensors. A temperature transmitter is also provided in the discharge header downstream of the exhaust fans for continuous monitoring of exhaust air temperature.

C1 Ventilation System (C1V)

C1 areas are normally occupied. C1 areas will typically consist of administrative offices, control rooms, conference rooms, locker rooms, rest rooms, and equipment rooms. C1 areas will be operated slightly pressurized relative to atmosphere and other adjacent areas.

C2 Ventilation System (C2V)

C2 areas will typically consist of non-process operating areas, equipment rooms, stores, access corridors, and plant rooms adjacent to areas with higher contamination potential. The C2V is served by dedicated air handling units and exhaust fans. Ventilation air supplied to C2 areas will be exhausted by the C2 exhaust system and cascaded into adjacent C3 areas. The sum of the volumetric flow rates exhausted by the C2 exhaust system and cascaded into adjacent C3 areas will be greater than the volumetric flow rate supplied to C2 areas. This will cause the C2 areas to maintain a nominal negative pressure relative to atmosphere. C2 exhaust will pass through one stage of HEPA filters and be discharged to the atmosphere by the exhaust fans. Supply and exhaust fans are provided with variable frequency drives.

C3 Ventilation System (C3V)

C3 areas are normally unoccupied, but allow operator access, for instance during maintenance. C3 areas will typically consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Air will generally be drawn from C2 areas and, wherever possible, cascaded through the C3 areas into C5 areas, or alternatively exhausted from the C3 areas by the C3 exhaust system. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms~~. When sufficient air cannot be cascaded into C3 areas, a dedicated C2 supply equipped with appropriate backflow prevention will be used~~. C3 exhaust will pass through one stage of HEPA ~~Filters~~ filters and be discharged to the atmosphere by the exhaust fans. C3 exhaust fans are provided with variable frequency drives.

C5 Ventilation System (C5V)
~~In general, air cascaded into the C5 areas will be from adjacent C3 areas. If there is a requirement for engineered duct entries through the C3 boundary, they will be protected by backflow HEPA filters, with penetrations through the boundary sealed~~Where there is in-bleed air from the C3 system to the C5 system, fan cascade trip interlocks protect the system from backflow.

The C5 areas in the LAW vitrification plant will be composed of the following:

- Pour caves
- ~~Drum~~ Container transfer tunnel
- Buffer storage area
- C3/C5 ~~Drain tank~~drains/sump collection vessel room
- Process cells
- Finishing line

Air will be cascaded into the C5 areas and exhausted by the C5 exhaust system. Engineered ~~duct~~ ventilation pipe entries (air in-bleeds) through the C5 confinement boundary will be protected by backflow ~~HEPA filter~~ isolation dampers. C5 exhaust will pass through two stages of HEPA ~~F~~filters and be discharged to the atmosphere by the exhaust fans. C5 exhaust fans are provided with variable frequency drives.

4.1.4 HLW Vitrification Plant

Figure 4A-4 presents a simplified process flow diagram of the HLW vitrification processes. The HLW vitrification plant will consist of several process systems designed to perform the following functions:

- Store pretreated HLW slurry
- Convert blended HLW slurry and glass formers into glass
- Treat melter offgas
- Handle IHLW ~~containers~~canisters
- Store IHLW containers
- Provide supporting equipment in the melter cave
- Handle miscellaneous waste
- Ventilate the HLW vitrification plant

~~Figure 4A-1 presents the simplified flow diagram for the WTP, Figure 4A-4 presents the simplified flow of primary process systems, and t~~The following figures located in Appendix 4A and drawings found in DWP ~~Appendix 4A~~Attachment 51, Appendix 10 provide additional detail for the HLW vitrification plant:

- Simplified flow diagram for the WTP
- ~~Simplified p~~Process flow figures and drawings for process information
- Typical system figures depicting common features for each regulated system
- ~~Simplified g~~General arrangement figures and drawings showing locations of regulated equipment ~~and associated tanks~~
- Waste management area figures and drawings showing plant locations to be permitted

Instrumentation, alarms, controls, and interlocks will be provided for the tank systems and miscellaneous treatment systems to indicate or prevent the following conditions, as appropriate:

- Overfilling: Plant items are protected against overfilling by liquid level indication, high level instrumentation interlocks to shut off feed sources, and process control system control functions backed up by hard wired trips as required.

- Loss of containment: Plant items are protected against containment loss by liquid level indication, and by process control system control and alarm functions as required, including shut off of feed sources. Each plant item that manages liquid mixed or dangerous waste is provided with secondary containment. Sumps associated with the management of mixed or ~~d~~dangerous waste are provided with liquid level instrumentation and an ejector or pump to empty the sump as needed.

- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or to the wrong location.

In addition to level control, temperature and pressure may be monitored for tank systems and miscellaneous treatment systems in some cases. Regulated process and leak detection system instruments and parameters will be provided in DWP Table III.10.E.G for tank systems and in DWP Table III.10.J.C for miscellaneous treatment sub-systems.

~~□Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant~~

Descriptions of the HLW vitrification process, melter offgas treatment systems, and IHLW glass container handling systems are provided in the following sections.

4.1.4.1 HLW Melter Feed Process

The following HLW melter feed ~~consists of the following:~~description is identical for both Melter 1 (HMP-MLTR-00001) and Melter 2 (HMP-MLTR-00002). The HLW melter feed process consists of the following:

- HLW concentrate~~Cave~~ ~~r~~Receipt ~~P~~process ~~s~~System (HCP)

- HLW ~~M~~melter ~~fr~~Feed ~~P~~process ~~S~~system (HFP)
- HLW g~~G~~lass f~~F~~ormers r~~R~~eagent ~~S~~system (GFR) (the GFR system does not manage dangerous waste and is provided for information only)

Figure 4A-26 presents a simplified process flow diagram of the HLW concentrate receipt process system (HCP) and the HLW melter feed process system (HFP). The primary function of this tank system is to receive HLW feed slurry from the pretreatment plant, mix glass formers with HLW feed to form a uniform blend, and provide a blended feed to the HLW melter. An analysis of the waste determines a glass additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste.

The ~~HLW melter feed system contains~~HCP system consists of the following vessel and associated ancillary equipment:

- ~~Two c~~Concentrate Receipt Vessels (~~V31001~~HCP-VSL-00001~~and V31002~~/2)

~~□Glass former feed hopper~~

The HFP system consists of the following vessels and associated ancillary equipment:

- Feed Preparation Vessel (~~V31101~~HFP-VSL-00001/5)
- HLW ~~HLW m~~Melter Feed Vessel (~~V31102~~HFP-VSL-00002/6)

The two Concentrate Receipt Vessels (HCP-VSL-00001/2), located in a wet process cell, receive HLW concentrate from the pretreatment plant. Process control samples are collected from these vessels and analyzed to determine the glass former formulation. Typically, the concentrate receipt vessels are operated in opposite cycles, where one vessel is filled and sampled while the other is being emptied. After completion of sample analysis, a batch of waste is transferred to ~~the~~ a Feed Preparation Vessels (HFP-VSL-00001/5) for blending with glass formers from the glass former feed hopper. The glass former feed hopper receives blended glass formers and reductant (such as silica, boric acid, calcium silicate, ferric oxide, lithium carbonate, and sucrose) from the ~~HLW~~ balance of facilities glass former ~~feed room~~system. After the blending, the glass formers are gravity-fed into the feed preparation vessel, where the blended glass formers are mixed with the HLW concentrate to form a uniform slurry. The slurry is then fed to ~~the~~ a HLW Melter Feed Vessels (HFP-VSL-00002/6) and then to the HLW melter process system (HMP).

~~Instrumentation, alarms, controls, and interlocks will be provided for the HCP and HFP systems to indicate or prevent the following conditions:~~

~~□Vessel overflow~~

~~□Loss of vessel integrity~~

~~□Loss of cooling water flow~~

~~□Loss of agitator function~~

~~□Agitator not operated at low liquid level to prevent agitator and/or vessel damage~~

~~High or low pressure, temperature, and/or Level instrumentation~~

~~Regulated HLW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.G.~~

Controls developed to prevent or mitigate ~~accident conditions~~equipment malfunction are incorporated into the design. The *Description of HLW Vitrification Bypass Events*, 24590-HLW-PER-PR-03-001 describes the ~~O~~operating conditions ~~that have been identified~~ that require interlocking with the melter feed involve individual components within the offgas system that could result in ~~overpressurization~~over pressurization of the melter. ~~These operating conditions include:~~

~~Failure of the standby offgas duct butterflypipe valve to open in response to melter surge~~

- ~~Insufficient airflow to film cooler or blockage of film cooler~~

The HLW GFR system contains glass former feed hoppers, located in a C3/R3 area on the roof of the HLW vitrification ~~facility~~plant, that receive blended glass formers and sucrose by dense-phase pneumatic conveyors from transporters. The transporters are located in the glass formers' room within the balance of facilities building.

The feed hoppers are equipped with filters to remove the dust from air used for pneumatic conveying and blending. It is anticipated that a series of single filter cartridges will be mounted on the top of the hoppers. The filters are cleaned by introducing compressed air through the cleaning nozzle to blow accumulated dust back into the hoppers. The feed hoppers are equipped with load cells to weigh the glass formers to confirm that the material in the upstream blending silo is conveyed to the feed hoppers. The load cells also confirm that the glass formers are transferred out of the feed hoppers to the melter Feed Preparation Vessels (HFP-VSL-00001/5).

Following the blending cycle, the glass formers are gravity-fed with a rotary feeder into the melter Feed Preparation Vessels (HFP-VSL-00001/5), where the blended glass formers are mixed with the waste feed. This equipment is located in an isolated area that serves as a contamination barrier between the ~~melter f~~Feed ~~p~~Preparation ~~v~~Vessels (HFP-VSL-00001/5) and the glass former supply. The rotary valve controls the rate of glass former addition into the ~~melter~~ Feed Preparation Vessels (HFP-VSL-00001/5)~~feed preparation vessels~~.

4.1.4.2 HLW Melter Process System (HMP) ~~System~~

Figure 4A-27 presents a simplified process flow diagram of the HLW melter process system (HMP). The primary functions of this miscellaneous treatment sub-system are to convert blended waste feed and glass formers into molten glass, deliver molten glass to HLW canisters, fill the canisters with molten glass waste, and monitor and control glass waste level during waste filling. The following melter process system, HMP, is identical for both HLW ~~m~~Melters (HMP-MLTR-00001/2).

~~The Each~~The HMP system includes the HLW Melters (HMP-MLTR-00001/2), two discharge chambers and two pour spouts, and primary and secondary canister level detection systems. The melter~~,~~ and pour spout~~, and level detection~~ will be remotely operated in a C5/R5 cell. There will be no personnel access to this cell after ~~hot~~ processing of the HLW feed stream begins.

HLW Melters (HMP-MLTR-00001/2)

The two HLW Melters (HMP-MLTR-00001/2), located in ~~the m~~melter ~~cell near the south wall~~cave no. 1 and melter cave no. 2, respectively, ~~is a~~ are rectangular ~~tank~~ in shape with an outer steel casing. ~~The~~ Each ~~tank~~ is lined with refractory material designed to withstand corrosion by molten glass. The steel casing for the melter area is provided with water cooling to maintain a thermal gradient in the bricks for corrosion control, prevent migration of glass through the bricks, and reduce heat load to the process cell. The lid of the HLW Melter will be sealed to the melter shell in order to provide gas containment. The lid will provide a support structure through which sub-components can be mounted. Penetrations~~, primarily on the lid, through the outer shell~~ are sealed by appropriate fittings that allow remote removal and replacement.

~~The~~ Waste feed ~~is introduced to the each melter through a tube that ends at the top of the feed nozzle. The feed nozzle is insulated to prevent drying the feed before it reaches the melter. Water flushes will be used to clear the feed lines as necessary. Feed~~ will be introduced to the melter as a slurry through insulated nozzles in the melter lid. ~~The melter feed nozzles are installed in the melter lid and provide a means to introduce feed slurry to the melter.~~ Each feed nozzle will be individually supplied from a slurry pump. The water and volatile feed constituents in the slurry will evaporate, leaving behind a layer of material known as the cold cap. Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the molten glass. As the slurry is fed, molten glass is formed that accumulates in the glass tank. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. The molten glass level in the melter is maintained between the top of the electrodes and below the upper edge of the glass contact refractory blocks. The rate of feed addition to the melter determines the cold cap coverage in the melt pool. The feed addition rate~~, and~~ can be controlled based on the average plenum temperature measured by thermocouples mounted in the melter lid. ~~The glass level in the melter is maintained between the top of the electrodes and below the upper edge of the glass contact refractory blocks. The water and volatile feed constituents in the slurry will evaporate, leaving behind a layer of material known as the *cold cap*. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the melt.~~ Air injectors may be used to mix and agitate the molten glass. ~~The slurry is fed at a constant rate to each melter. As the slurry is fed, molten glass is formed that accumulates in the glass tank.~~ When the melt level rises to a predetermined upper limit, it is discharged to a ~~container~~canister. ~~The feed system includes the melter feed nozzles and plenum thermocouples. The melter feed nozzles are installed in the melter lid and provide a means to introduce feed slurry to the melter. Each feed nozzle will be individually supplied from a slurry pump. The rate of feed addition to the melter determines the cold cap coverage in the melt pool, and can be~~

~~controlled based on the average plenum temperature. The glass level in the melter is maintained between the top of the electrodes and below the upper edge of the glass contact refractory blocks.~~

~~The~~ Each Melter (HMP-MLTR-00001/2) includes three important regions: the glass pool, two discharge chambers, and a plenum just above the glass pool. Melter pool level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels. Each discharge chamber is a heavily insulated box on the south side of the melter, housing the discharge trough and a connection flange for the pour spout assembly. The plenum is lined with refractory to withstand hot corrosive gases, thermal shock, and slurried waste splatter.

The power to the electrodes is regulated by the ~~PCS~~ process control system to maintain the temperature at the set point value.

The heat for the HLW ~~melter~~ Melter startup is provided by temporarily installed radiant electric heaters mounted on the lid of the melter. These heaters melt the glass formers sufficiently to make it ionically conductive between the ~~melter's~~ Melter's joule heating electrodes. When a conducting path is established, the ~~melter~~ Melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as *joule heating*). After some time the ~~melter~~ Melter reaches its operating temperature (generally in the range of 950 °C to 1,250 °C) and slurry feeding can start. As the slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it can be discharged into a ~~container~~canister.

The gas produced during melting is mainly steam and contains volatile components and airborne matter that require removal prior to discharge to the atmosphere. This offgas is diluted by air from four sources; inadvertent air in-leakage through the ~~melter~~ Melter lid and discharge port, instrumentation and sparging, film cooler air, and air added to control the ~~melter~~ Melter vacuum. The ~~melter~~ Melter plenum is maintained at a vacuum with offgas system blowers and control injection of air into the offgas line near the ~~melter~~ Melter exhaust. This assures containment and avoids ~~m~~Melter pressurization. This vacuum is sensed at a location near the plenum where blockage and feed splatter is unlikely. The sensed vacuum is used to drive a control valve that regulates the draft in the ~~melter~~ Melter exhaust line.

The glass level in the Melters (HMP-MLTR-00001/2) is maintained between the top of the upper electrodes and below the upper edge of the tank blocks. The level is determined directly by two bubbler tubes that indicate density and glass depth. Thermocouples housed in thermowells that penetrate the cold cap and are immersed in the molten glass also indicate molten glass level. Level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels.

Glass Discharge System

Discharge is achieved by transferring glass from the bottom of the melt pool up through a riser and out of the ~~melter~~ Melter through a side discharge chamber. Under each of the two discharge chambers there is a pour spout that connects the ~~melter~~ Melter discharge chamber to the respective HLW canister.

The glass level in the ~~m~~Melter is maintained between the top of the electrodes and the overflow level of the discharge trough. The ~~m~~Melter glass pool level will be measured to indicate when to start and stop glass discharge. Each ~~m~~Melter has two independently operated glass discharge systems, adjacent to each other on one side of the ~~m~~Melter. Each system includes an airlift riser, an airlift lance, a glass pour trough, and a heated discharge chamber. Glass is discharged by introducing gas into the molten glass in the discharge riser. The gas increases the level in the riser, causing the molten glass to flow down the trough and fall from the tip of the trough into the canister. When the desired level in the canister is reached, the air lift gas is turned off, and the glass level in the riser recedes stopping the flow of glass to the canister. ~~With the pour spout assembly retracted and its slide gate closed, a canister is moved into position under the pour spout. The pour spout slide gate seals the opening, preventing large quantities of air from entering the melter and preventing glass drips from falling into the canister tunnel. When a canister is in position under the pour spout, the pour spout is lowered into position by extending the pour spout bellows. The slide gate is then opened and glass drips or fibers collected on the slide gate, while the pour spout assembly was in standby, will be scraped off into the canister. After verification of the slide gate and pour spout positions, the canister is ready to receive glass.~~ During pouring operations, a remote camera is used to view the pour stream within the pour spout assembly.

The camera is for observation only and is not a regulated operation.

~~The canister level detector monitors the glass fill height and is used to control the molten glass level within the HLW canister, as it is poured from the melter. Once the canister is filled, pouring is terminated and the canister is allowed to cool. After cooling, the slide gate closes and the pour spout lifts away from the canister, compressing the pour spout bellow. After verification of the slide gate and pour spout positions, the canister is transported to the lidding assembly.~~

~~As the canister is transported to the lidding assembly, a standby canister is placed under the pour spout and the pour spout is lowered into position by extending the pour spout bellows to create a metal-to-metal seal with the standby canister. The slide gate is then opened and glass drips or fibers collected on the slide gate while the pour spout assembly was in standby will be scraped off into the standby canister. When a new canister is ready to be placed under the pour spout, the process is repeated again.~~

Level Detection

The purpose of each canister level detection system is to monitor the molten glass level within the HLW canister and to prevent canister overfilling. During glass pour, the level detection system is used to monitor the glass level to ~~assure~~ ensure the canister is filled to the desired level. The level detection system also will be able to monitor the rate at which the glass level is rising in the canister. There is a primary and a secondary monitoring system, which is consistent with standard vessel level control. A primary system that operates through the ~~PCS~~ process control system is used for normal operations, and a secondary "hard-wired" system is used to back up the primary system and automatically shut down the fill before the overflow limit is reached. The primary level detection system is a thermal imaging system that provides continuous level monitoring over the entire canister. In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system ~~shall~~ will indicate a filled canister.

During glass pour, the level detection system will display a thermal image on a monitor ~~in the central control room~~ and will utilize a serial connection to interface with the ~~PCS~~ process control system for indication and control purposes. The imaging software will be used to continuously monitor the level of glass in the canister and will provide an output of the glass level to control loops in the ~~PCS~~process control system. A high-level condition will be indicated by the process control system~~PCS~~, which will initiate alarms and/or control sequences to control the melter pour. The infrared image will be available through the plant closed circuit television system. The control system will be able to store the level of the glass in a canister between batch pours when the temperature in the canister could be cooled down sufficiently to prevent the thermal imaging system from detecting the glass level. The level is reset to zero with each new canister. The control system will also be used to monitor the average temperature of the glass near the top of the pour. If the temperature is lower than a set point value, an alarm will be initiated by the process control system~~PCS~~.

Another function of the system is to detect the rate at which the glass level is rising in the canister. This gives an indication of deviation between expected normal pour rates. Deviation could indicate a malfunction of the glass discharge system, and an alarm would be initiated.

In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system ~~shall~~ would prevent a canister overfill. This system is designed only to detect a discrete high glass level, producing a contact closure when the high level is sensed. When the high level has been reached, the system will automatically shut down the melter gas lift which, in turn, will stop the glass pour. The system is limited to discrete levels of glass fill, not continuous monitoring.

Instrumentation, alarms, controls, and interlocks will be provided for the HMP system to indicate or prevent the following conditions:

~~The slide gate cannot be opened without verification that the pour spout is attached to a canister~~

~~The melter cannot pour glass without verification that the slide gate is open~~

- The melter cannot pour without verification that the bogie is present
- The melter cannot pour without verification that the canister is present
- The melter cannot pour if the canister is greater than 95 % full

~~Regulated HLW vitrification plant miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.J.C.~~

4.1.4.3 Melter Offgas Treatment Process System (HOP) ~~System~~

~~The HLW Melter Offgas Treatment Process System~~The ~~(~~HOP~~)~~ system is composed of tanks and miscellaneous treatment sub-systems, separated into the primary and secondary melter offgas treatment systems. ~~The HOP system consists of the following subsystems:~~

~~HLW primary offgas system~~

~~HLW vessel vent system~~

~~HLW secondary offgas system~~

~~Tanks~~

~~SBS Condensate Receiver Vessel (HOP-VSL-00903/4)~~

~~Miscellaneous Treatment Sub-Ssystems~~

~~Film Cooler (HOP-FCLR-00001/2)~~

~~Submerged BBed SScrubber (HOP-SCB-00001/2)~~

~~Air Ejector Induced Siphon (located on HOP-SCB-00001/2)~~

~~Wet Electrostatic Precipitators (HOP-WESP-00001/2)~~

~~High- efficiency mist eliminators (HEME)(HOP-HEME-00001A/1B/2A/2B)~~

~~Electric Heaters (HOP-HTR-00001B/2A/5A/5B)~~

~~HEPA Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B)~~

~~Fans (HOP-FAN-00001A/1B/1C/9A/9B/9C)~~

~~Activated Carbon Columns (HOP-ADBR-00001A/1B/2A/2B)~~

~~Heat Exchangers (HOP-HX-00001/2/3/4)~~

~~Silver Mordenite Columns (HOP-ABS-00002/3)~~

~~Offgas Organic Oxidizers (HOP-SCO-00001/4)~~

~~NO_x Selective Catalytic Reducers (HOP-SCR-00001/2)~~

~~Fans (HOP-FAN-00008A/8B/8C/10A/10B/10C)~~

- ~~HLW stack~~

Melter offgas is generated from the vitrification of HLW in the joule-heated ceramic melter. The rate of generation of gases in the melter is dynamic and not steady state. ~~The~~ Each HLW Melter (HMP-MLTR-00001/2) generates offgas resulting from decomposition, oxidation, and vaporization of feed material. Constituents of the offgas include:

- Nitrogen oxides ~~(NO_x)~~ from decomposition of metal nitrates in the melter feed
- Chloride, fluoride, and sulfur as oxides, acid gases, and salts

~~Dangerous waste metals~~

~~Dangerous waste organics~~

- ~~Radionuclide p~~Particulates and aerosols

• Entrained feed material and glass

In addition, the HLW Melters (HOP-MLTR-00001/2) generates small quantities of other volatile compounds including iodine-129, carbon-14, tritium, and volatile organic compounds. The carbon-14 and tritium emissions are in the form of ~~CO_2~~ carbon dioxide and water, respectively.

The HOP system is divided into a primary system and a secondary system. The purpose of the HOP system is to cool and treat the ~~melter~~ Melter offgas and vessel ventilation offgas to a level that is protective of human health and the environment. The offgas system must also provide a pressure confinement boundary that will control ~~melter~~ Melter pressure and prevent vapor release to the plant. The design of the melter offgas system must accommodate changes in offgas flow from the Melter (HOP-MLTR-00001/2) without causing the melter to pressurize.

Initial decontamination of offgas from the melter is provided by the primary offgas treatment system. This primary offgas system is designed to handle intermittent surges of seven times steam flow and three times non-condensable flow from feed. The primary system consists of a film cooler, submerged bed scrubber, a wet electrostatic precipitator, and a high efficiency mist eliminator. This system cools the offgas and removes particulates.

Additionally, an extra line from the Melter (HOP-MLTR-00001/2) to the Submerged Bed Scrubber (HOP-SCB-00001/2) is provided in the unlikely case that the primary offgas line plugs. This extra line includes a valve as the isolation device. As soon as the ~~melter~~ Melter vacuum decreases to a set point, the valve is actuated and offgas flow is allowed through the line to the Submerged Bed Scrubber, thereby preventing melter pressurization. In the event that the ~~melter~~ Melter surge is much higher than the system is designed to handle, a pressure relief valve acts as the pressure relief point venting the offgas to the melter ~~cell~~cave. Offgas from the ~~m~~Melter cave is drawn through HEPA Filters to remove particulates and discharged to the atmosphere. Once the ~~m~~Melter pressure is back to the desired set point, the valve closes.

The vessel ventilation system offgas consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents. The vessel ventilation header joins the primary offgas system after the Wet Electrostatic Precipitators (HOP-WESP-00001/2). After the ~~high efficiency mist eliminator~~HEPA Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B), the offgas is routed to the secondary offgas treatment system. ~~The offgas received through the vessel ventilation system consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents.~~

~~The secondary offgas system (after the HEPA filters to final discharge) is designed to handle maximum sustained flowrate from the melter. The secondary offgas system consists of the following major components:~~

~~□Heat recovery unit~~

~~□Exhauster fans (two sets)~~

~~□Catalytic oxidizer/reducer unit~~

~~□Electric preheater~~

~~□Iodine absorption column~~

~~□Submerged bed scrubber condensate collection vessel (V32101)~~

The following sections provide descriptions of major melter offgas treatment components and are identical for both Melter 1 (HMP-MLTR-00001) and Melter 2 (HMP-MLTR-00002).~~:~~

~~Additional information for the HOP tank system is provided in the following documents located in Attachment 51, Appendix 10:~~

~~*Flooding Volume for HLW Facility* (24590-HLW-PER-M-02-003)~~

~~*HLW Facility Sump Data* (24590-HLW-PER-M-02-001)~~

4.1.4.3.1 Primary Melter Offgas Treatment System (HOP)

DWP Attachment 51, Appendix 10.1 contains a process flow diagrams of the primary melter offgas treatment process system (HOP)(24590-HLW-M5-V17T-P0003). The purpose of the primary offgas treatment system is to cool the melter offgas and to remove offgas aerosols and particulates generated by the ~~melter~~ Melter (HMP-MLTR-00001/2) and from the vessel ventilation air. This treatment system consists of ~~a~~the following:

Tanks

- SBS Condensate Receiver Vessels (HOP-VSL-00903/4)

Miscellaneous Treatment Sub-Systems

- Film Coolers (HOP-FCLR-00001/2)~~, a~~
- Submerged Bed Scrubbers (HOP-SCB-00001/2)~~, a~~
- Wet Electrostatic Precipitators (HOP-WESP-00001/2)~~, a~~
- High~~- efficiency~~ Efficiency ~~mist~~ Mist ~~eliminator~~ Eliminators (HEME)(HOP-HEME-00001A/1B/2A/2B)~~, an~~
- Electric Heaters (HOP-HTR-00001B/2A/5A/5B)~~, and~~
- High ~~efficiency~~ Efficiency ~~particulate~~ Particulate ~~air~~ Air (HEPA) Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B)~~.~~

~~Regulated HLW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.G.~~

~~Regulated HLW vitrification miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.J.C.~~

Film Coolers (HOP-FCLR-00001/2)
The function of the Film Cooler (HOP-FCLR-00001/2) miscellaneous treatment sub-system is to cool the offgas and entrained molten glass droplets below the glass sticking temperature to minimize ~~solids~~ glass deposition on the offgas piping walls. The offgas exits the Melter (HMP-MLTR-00001/2) and is mixed with air in the offgas Film Cooler. The Film Cooler is a double-walled pipe designed to introduce injected gas axially along the walls of the offgas pipe through a series of holes or slots in the inner wall. Each melter has a single Film Cooler. ~~The Film Cooler is a double-walled pipe designed to introduce injected gas axially along the walls of the offgas pipe through a series of holes or slots in the inner wall.~~

A mechanical reamer may be mounted on the Film Cooler (HOP-FCLR-00001/2) to periodically remove solids build-up on the inner film cooler wall. The reaming device (wire brush or drill) would be periodically inserted into the film cooler for mechanical solids removal.

Submerged Bed Scrubber (HOP-SCB-00001/2)
The offgas from the HLW melter Film Cooler (HOP-FCLR-00001/2) ~~is further cooled and treated by a submerged bed scrubber. The offgas~~ enters the Submerged Bed Scrubber (HOP-SCB-00001/2) ~~column~~ miscellaneous treatment sub-system for further cooling and solids removal. The Submerged Bed Scrubber is a passive device designed for aqueous scrubbing of entrained ~~radioactive~~ particulate from melter offgas, cooling and condensation of melter vapor emissions, and interim storage of condensed fluids. It will also quench the offgas to a desired discharge temperature through the use of ~~coiling~~ cooling coils/jacket. The offgas leaves the Submerged Bed Scrubber in thermal equilibrium with the scrubbing solution.

The Submerged bed Scrubber (HOP-SCB-00001/2) has one offgas inlet. The offgas enters the Submerged Bed Scrubber through the inlet pipe that runs down through the center of the bed to the packing support plate. The bed-retaining walls extend below the support plate, creating a lower skirt~~,~~ to allow the formation of a gas bubble underneath the packing. The entire bed is suspended off the floor of the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber to allow the scrubbing solution to circulate freely through the bed. After formation of the gas bubble beneath the packing, the injected offgas then bubbles up through the packed bed. The rising gas bubbles also cause the scrubbing liquid to circulate up through the packed bed, resulting in a general recirculation of the scrubbing solution. The packing breaks larger bubbles into smaller ones to increase the gas to water contacting surface, thereby increasing particulate removal and heat transfer efficiencies. The warmed scrubbing solution then flows downward outside of the packed bed through ~~coiling~~ cooling coils/jacket.

To maintain a constant liquid level within the Submerged Bed Scrubber (HOP-SCB-00001/2), it will be equipped with an overflow line that allows for the continuous discharge of offgas condensate and some scrubbed particulates to the SBS Condensate ~~collection~~ Receiver Vessels (HOP-VSL-00903/4) ~~located next to the submerged bed scrubber column vessel~~. The ~~submerged~~ SBS~~bed scrubber~~ eCondensate ~~collection r~~Receiver ~~vessel~~ Vessels ~~is~~are also ~~is~~ equipped with a cooling jacket. The rate of condensate discharge is determined by how much the offgas temperature is lowered below its dew point. The condensate and some collected particulates overflow into the ~~submerged~~ SBS~~bed scrubber~~ eCondensate ~~collection r~~Receiver

~~vessel~~Vessel. To minimize the buildup of the solids in the bottom of the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~Scrubber, condensate from the ~~submerged~~ SBS~~bed scrubber~~ ~~c~~Condensate ~~collection r~~Receiver ~~vessel~~ Vessels (HOP-VSL-00903/4) will be re-circulated back to the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber and injected through multiple lances to agitate and suspend solids on the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber vessel floor. The collected solids will then be pumped directly off the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber vessel floor to the ~~condensate storage~~~~radioactive liquid disposal system vessel~~Plant Wash and Drains Vessel (RLD-VSL-00008). This purging and recycling process occurs simultaneously. Venting of this condensate receiver vessel is via the submerged bed scrubber into the main offgas discharge pipe.

The scrubbed offgas discharges through the top of the submerged bed scrubber and is routed to the Wet ~~Wlectrostatic~~Electrostatic Precipitator (HOP-WESP-00001/2) for further particulate removal.

Wet Electrostatic Precipitator (HOP-WESP-00001/2)

The Submerged Bed Scrubber offgas is routed to the Wet Electrostatic Precipitator (HOP-WESP-00001/2) miscellaneous treatment sub-system for removal of aerosols down to and including sub-micron size. The offgas enters ~~at the top of~~ the unit and may pass through a distribution plate. The evenly distributed saturated gas then flows up ~~downward~~ through the tubes~~. The tubes~~ which act as the positive electrodes. Each of these tubes has a single negatively charged electrode, which runs down the centerline of each tube. A high-voltage, direct current transformer supplies the power to the electrodes. A strong electric field generated along the electrodes ~~giving~~ gives a negative charge to the aerosols. The negatively charged particles move toward the positively charged tube walls for collection. Collected particles are then washed from the tube walls along with collected mists. As the gas passes through the tubes, the first particles captured are the water droplets. As the water droplets gravity drain through the electrode tubes the collected particles are washed off and the final condensate is collected in the wet electrostatic precipitator dished bottom area. A water spray may be used periodically to facilitate washing collected aerosols from the tubes. The tube drain and wash solution ~~are~~ is routed to ~~a collection~~the SBS Condensate Receiver Vessels (HOP-VSL-00903/4).

High-Efficiency Mist Eliminators (HOP-HEME-00001A/1B/2A/2B)

Further removal of ~~radioactive~~ aerosols is accomplished using the ~~h~~High-~~e~~Efficiency ~~mist~~ Mist ~~eliminator~~ Eliminator (HEME). The HEME miscellaneous treatment sub-systems also reduce the dust-loading rate on the HEPA ~~f~~Filters. ~~A~~ Each HEME is essentially a high-efficiency demister that has a removal efficiency of greater than 99 % for aerosols down to the sub-micron size. As the offgas passes through the HEME (HOP-HEME-00001A/1B/2A/2B), the liquid droplets and other aerosols within the offgas interact with High-Efficiency Mist Eliminators' ~~high-efficiency mist eliminator~~ filaments. As the aerosols contact the filaments they adhere to the filaments surface by surface tension. As the droplets agglomerate and grow, they eventually acquire enough mass to fall by gravity to the bottom of the unit, thus overriding the original surface tension, friction with the filaments, and the gas velocity. These collected droplets are assumed to contain the majority of the offgas radioactivity and will be collected in the bottom of the High-Efficiency Mist Eliminators~~HEME~~ (HOP-HEME-00001A/1B/2A/2B). The collected condensate will gravity drain into the SBS Condensate ~~collection~~ Receiver Vessel (HOP-VSL-00903/4). As the condensate flows down through the filter bed, a washing action is generated that will help wash collected solids from the filter elements. However, some solids may accumulate in the bed over time, causing the pressure drop across the filter to increase. When the pressure drop across the High-Efficiency Mist Eliminators~~HEME~~ reachess a predefined level, it is washed with ~~process~~ water to facilitate removal of accumulated solids. Some insoluble solids may remain, and their accumulation will eventually lead to the replacement of the High-Efficiency Mist Eliminators'~~HEME~~ filter elements.

HEPA Electric Heaters (HOP-HTR-00001B/2A/5A/5B)~~,~~ and Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B)~~ and Exhauster~~

Next, the offgas is heated using an HEPA Electric Heaters (HOP-HTR-00001B/2A/5A/5B) to a temperature above the gas streams dew point and then passed through dual set of HEPA Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B) to provide high--efficiency submicron removal. The offgas is heated to avoid condensation in the HEPA ~~f~~Filters. ~~The HEPA filters provide a combined particulate removal efficiency greater than 99.999 %~~. When the differential pressure drop across the filters becomes too high, they will be remotely changed out. The system is ~~comprised~~ composed of two parallel HEME/Electric H~~h~~eater/HEPA ~~filter~~ Filter trains. The offgas passes through one train while the other remains available as an installed backup.

Maintenance Ventilation Bypass

A maintenance bypass will also be installed, allowing the ~~melter~~ Melter offgas to bypass the Film Cooler (HOP-FCLR-00001/2), the Submerged Bed Scrubber (HOP-SCB-00001/2), and the Wet Electrostatic Precipitator (HOP-WESP-00001/2)~~. This bypass would only be used after the HLW melter has been idled and the cold cap eliminated~~. The bypass line would feed ~~gas~~ into the ~~secondary offgas system for~~ HEME/HEPA filtration and other gas cleaning steps. Prior to initiating use of the maintenance ventilation line, waste feed would be secured, and the melter placed into an idle condition. No waste feed would be fed to the affected melter when the maintenance ventilation line is in use. The *Description of HLW Vitrification Bypass Events*, 24590-HLW-PER-PER-03-001, provides additional information on HLW bypass events.

~~Vessel Ventilation Offgas Treatment~~

~~The vessel ventilation offgas system prevents migration of waste contaminates into the process cells and potentially operating areas. It does this by maintaining the various HLW process vessels under a slight vacuum relative to the cell. The composition of the ventilation air is expected to be primarily air with slight chemical and radioactive particulate contamination.~~

~~The vessel ventilation air is combined with the melter offgas prior to entering the primary offgas system high efficiency mist eliminators. The combined air streams are treated together in the remaining sections of the primary and secondary offgas treatment systems. A pressure control valve is used to regulate the pressure between the vessel ventilation offgas system and the melter offgas system.~~

~~HLW Pulse Ventilation System~~

~~Gaseous emissions are produced by pulse jet mixers and reverse flow diverters that are used to mix and move wastes in the HLW vitrification plant. The exhausts from reverse flow diverters and pulse jet mixers throughout the HLW vitrification plant are collected in the pulse ventilation system headers. This exhaust is potentially contaminated with aerosols and particulates. Electric preheaters eliminate liquid aerosols and reduce the relative humidity of the gas stream, as necessary, before it encounters the system HEPA filters. The gas is passed through HEPA filters to remove particulates that may be present. When the differential pressure drop or radiation level across the filters becomes too high, they will be remotely changed out.~~

4.1.4.3.2 Secondary Offgas Treatment System (HOP)

Figure 4A-29 presents a simplified process flow diagram of the secondary offgas treatment system (HOP). There is one secondary offgas treatment train for each HLW Melter. The combined primary offgas stream and vessel ventilation offgas stream is discharged to the secondary offgas treatment system. The secondary offgas system will treat the combined offgas to a level protective of human health and the environment. Specifically, the secondary offgas treatment system will remove radioactive iodine, volatile organic compounds, and acid gases ~~(HCl, HF, NO_x)~~, as required, to meet the ~~facilities~~ facility's air discharge requirements. The secondary offgas treatment system consists of the following miscellaneous treatment sub-systems:

- Activated Carbon Columns (HOP-ADBR-00001A/1B/2A/2B)~~,~~
- Silver Mordenite Columns (HOP-ABS-00002/3)~~,~~
- Offgas Organic Oxidizers (HOP-SCO-00001/4)~~,~~
- NO_x Selective Catalytic Reduction Units (HOP-SCR-00001/2)~~,~~
- ~~and a silver mordenite column~~Heat Exchangers (HOP-HX-00001/2/3/4)~~,~~
- Booster Fans (HOP-FAN-00001A/1B/1C/9A/9B/9C)~~,~~
- Stack Fans (HOP-FAN-00008A/8B/8C/10A/10B/10C)~~, and~~
- HLW stack.

~~Regulated HLW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.G.~~

~~Regulated HLW vitrification miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.J.C.~~

Activated Carbon Column (HOP-ADBR-00001A/1B/2A/2B)
The Activated Carbon Column miscellaneous treatment sub-system removes volatile mercury from the offgas. The activated carbon column will contain a total of four beds (two per ~~m~~Melter). The offgas normally flows through both beds in series. When gaseous mercury is detected breaking through the leading bed, the offgas flow is manually changed to make the trailing bed the leading bed, and only one column is used while the exhausted bed is removed and replaced. The flow is then changed to make the fresh bed the trailing bed.

The activated carbon particles are batch loaded into the bed by gravity. The spent activated carbon is batch removed by gravity and a pneumatic conveyor for collection in containers. A water fire suppression system is included as a precaution against activated carbon fires.

Silver Mordenite Columns (HOP-ABS-00002/3)
Two Silver Mordenite Column miscellaneous treatment sub-systems (one for each ~~m~~Melter) will be located in the HLW vitrification plant. The Silver Mordenite Columns will be used to remove gaseous radioactive iodine (I-129) and other gaseous halogens, such as fluorine and chlorine. The ~~s~~Silver ~~m~~Mordenite ~~c~~Columns (HOP-ABS-00002/3) will consist of approximately 36 silver mordenite adsorbers mounted in a bank configuration to a mounting frame within a housing. Offgas will enter the upper (or inlet) plenum of each ~~s~~Silver ~~m~~Mordenite ~~c~~Column, flow in parallel through the adsorbers to the lower (or exit) plenum, pass through a replaceable roughing filter, and exit. The columns' design will allow manual removal and replacement of adsorbers. Adsorbers will be sized to fit into standard 55 gallon waste drums for disposal.

The silver mordenite adsorbers are essentially cartridges filled with silver mordenite. Silver mordenite is a silver zeolite adsorption media in the form of cylindrical pellets. Halogens will react with the silver in the bed and become trapped within the matrix. Halogens are not loaded uniformly within the ~~s~~Silver ~~m~~Mordenite ~~a~~Adsorber cartridges. Adsorption reactions occur within an action zone (or mass transfer zone) that varies in length depending on the temperature of the bed and the gas velocity through the bed. Halogens will begin loading at the beginning of the silver mordenite beds and progressively load the silver through the column until breakthrough is reached at the end of the column. Once halogen breakthrough occurs or a predetermined lifespan is reached, the silver mordenite adsorbers will require replacement.

Offgas Organic ~~Thermal Catalytic~~ Oxidizer/~~Reducer Unit~~ (HOP-SCO-00001/4) and NO_x Selective Catalytic Reduct~~ion Unit~~er (HOP-SCR-00001/2)
A catalyst skid-mounted unit with a combined Offgas Organic Oxidizers (HOP-SCO-00001/4) and a NO_x Selective Catalytic Reducers (HOP-SCR-00001/2) miscellaneous treatment sub-systems will be used ~~T~~to remove products of incomplete combustion~~,~~; volatile organics compounds, carbon monoxide, and ~~NO_x~~ nitrogen oxide compounds in the offgas stream, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream)~~ a catalyst skid -mounted unit with a combined thermal Offgas catalytic Organic oxidizer Oxidizer (HOP-SCO-00001/4) unit and a NO_x selective Selective catalytic Catalytic rReduction uniter (HOP-SCR-00001/2) will be used. In this these miscellaneous unittreatment sub-systems, organic compounds are oxidized to carbon dioxide, water vapor, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream). Also, NO_x isnitrogen oxides are reacted with ammonia to reduce it to nitrogen gas and water vapor.~~

The offgas is first treated in the Offgas Organic Oxidizers (HOP-SCO-00001/4) where organic compounds, carbon monoxide, and possibly acid gases are oxidized to carbon dioxide and water vapor. These reactions are exothermic. The Offgas Organic Oxidizer operates at a temperature low enough to prevent the formation of additional nitrogen oxides.

After the Offgas Organic Oxidizers (HOP-SCO-00001/4), the offgas is heated through a plate heat exchanger and an electric heater to bring the offgas up to the operational temperature of the NO_x Selective Catalytic Reducers (HOP-SCR-00001/2).

The heated offgas enters the NO_x Selective Catalytic Reducers (HOP-SCR-00001/2), where ammonia is injected through an atomized spray and allowed to mix with the offgas. The nitrogen oxides are reduced by the ammonia to nitrogen gas and water. Two sets of NO_x Selective Catalytic Reducers (HOP-SCR-00001/2) are arranged in series. The offgas is treated through the first of the NO_x Selective Catalytic Reducer (HOP-SCR-00001). After the first NO_x Selective Catalytic Reducer (HOP-SCR-00001), more ammonia is injected into the offgas to allow further conversion in the second NO_x Selective Catalytic Reducer (HOP-SCR-00002). The reduction reaction is also exothermic, significantly increasing the offgas temperature. The hot offgas is the heating media for the heat exchanger discussed above. The cooled offgas stream is then directed to the Caustic Scrubber for acid gas removal and final cooling.~~The volatile organic compound catalyst columnthermaOffgasl catalyticOrganic oOxidizer unit (HOP-SCO-00001/4) operates at a somewhat lower temperature thanis placed in front of the NO_x catalystsSelective cCatalytic rReductioner unit (HOP-SCR-00001/2); therefore, it is placed at the beginning of the unit. This arrangement also prevents the formation of NO_x nitrogen oxides through the volatile organic compound catalyst from the oxidation of ammonia, which is added after the gas goes through the volatile organic compound catalyst. Further offgas heating occurs through the volatile organic compounds catalyst, as the reactions occurring are exothermic, although it is not a significant source of heat.~~

~~As the offgas enters the Offgas unitoOrganic thermal catalytic oOxidizer unit (HOP-SCO-00001/4), it travels through the heat recovery unit, which is a plate heat exchanger. The heating medium used is the exhaust from the NO_x sSelective cCatalytic oxidizer/reducerrReductioner unit (HOP-SCR-00001/2). The cool offgas enters the cold side of the heat recovery, then passes through an electric heater to bring the temperature up to that required for the Offgas volatile oOrganic compound catalystthermal catalytic Ooxidizer unit antd the NO_x sSelective cCatalytic rReducer to operate.~~

~~After the Offgas volatile organicOrganic compound catalystthermal catalytic oOxidizer unit, the offgas enters the NO_x sSelective cCatalytic rReduction uniter (HOP-SCR-00001/2)a chamber where gaseous ammonia is injected through an atomized spray and allowed to mix with the offgas. Ammonia is added so that the NO_x nitrogen oxide reduction reactions can be carried out. Reduction of NO_x nitrogen oxides is also an exothermic reaction;, therefore, it significantly increases the offgas temperature. This hot offgas then enters the hot side of the heat recovery unit to heat the incoming offgas. The cooled offgas stream is then directed to the silver mordenite column for iodine and acid gas removal.~~

~~Silver Mordenite Column~~

~~The silver mordenite column is present to remove halogens such as radioactive iodine, fluorine, and chlorine from the melter offgas. Silver mordenite is an absorbent in the form of cylindrical pellets contained in cartridges. The absorbent is expected to lose effectiveness over time and will require replacement. Halogens react with the silver in the bed and are trapped within the~~

~~matrix. Loading begins at the front of the silver mordenite beds and progressively load the silver through the column until breakthrough is reached at the end of the column. Absorption reactions occur within a reaction zone (or mass transfer zone) that varies in length depending on the temperature of the bed and the gas velocity through the bed. The reaction zone length within a silver mordenite bed is readily apparent through the use of a transparent column since the there is a color change as the reaction progress. The silver mordenite pellets will change color from white, to yellow, and finally a purple color, once the silver is consumed. The column structure is similar to that in a carbon bed absorber. The "column" is not a tank-like structure, but is instead a bank of cartridges through which the gas stream is directed. The absorbent cartridges allow for manual removal and replacement when required or after a predetermined life span, and are sized to fit into standard waste containers for disposal.feet feet feet~~

~~4.1.4.3.3~~4.1.4.4 Process Vessel Vent~~ilation Offgas Treatment~~ System (PVV)

The process vessel vent~~ilation offgas~~ system consists of offgas pipe. This miscellaneous treatment sub-system equipment prevents migration of waste contaminantes into the process cells and potentially operating areas. It does this by maintaining the various HLW process vessels under a slight vacuum relative to the cell. The composition of the ventilation air is expected to be primarily air with slight ~~chemical and radioactive~~mixed waste particulate contamination.

The vessel ventilation air is combined with the melter offgas prior to entering the primary offgas system high-efficiency mist eliminators. The combined air streams are treated together in the remaining sections of the primary and secondary offgas treatment systems. A pressure control valve is used to regulate the pressure between the vessel ventilation offgas system and the melter offgas system.

~~Regulated HLW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.G.~~

~~Regulated HLW vitrification plant miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.J.C.~~

~~4.1.4.4~~4.1.4.5 HLW Pulse Jet Ventilation System (PJV)

The PJV system consists of the following miscellaneous treatment ~~unit~~ sub-systems:

- HEPA ~~f~~Filters (PJV-HEPA-00004A/4B/5A/5B)
- Electric ~~h~~Heaters (PJV-HTR-00002)
- Pulse ~~j~~Jet ~~f~~Fans (PJV-FAN-00002A/B)

Gaseous emissions are produced by pulse jet mixers and reverse flow diverters that are used to mix and move wastes in the HLW vitrification plant. The exhausts from reverse flow diverters and pulse jet mixers throughout the HLW vitrification plant are collected in the pulse ventilation system headers. This exhaust is potentially contaminated with aerosols and particulates. Electric ~~preh~~Heaters (PJV-HTR-00002) eliminate liquid aerosols and reduce the relative humidity of the gas stream, as necessary, before it encounters the system HEPA ~~f~~Filters (PJV-HEPA-00004A/ 4B/5A/5B). The gas is passed through HEPA ~~f~~Filters to remove particulates that may be present. When the differential pressure drop, they will be remotely changed out.

~~Regulated HLW vitrification miscellaneous treatment sub-system process and leak detection system instruments and parameters will be provided in Table III.10.J.C.~~

~~4.1.4.5~~4.1.4.6 Radioactive Liquid Waste Disposal System (RLD)~~-System~~

Figure 4A-31 presents a simplified process flow diagram of the radioactive liquid waste disposal system (RLD). The primary functions of the RLD tank system are to receive, store, and transfer various effluents from different HLW treatment systems~~ for collection and handling~~. Various operations, such as neutralization, mixing, and sampling of the waste, are performed by these systems as required.

The RLD system contains ~~four~~ three ~~vessels~~ tanks located in the HLW vitrification plant wet process cell:

- Acidic ~~waste~~ Waste ~~vessel~~ Vessel (~~V35002~~RLD-VSL-00007)
- Plant ~~wash~~ Wash and ~~drains~~ Drains ~~vessel~~ Vessel (~~V35003~~RLD-VSL-00008)
- ~~Decontamination effluent collection vessel (V35009)~~
- Offgas ~~drains~~ Drains ~~collection~~ Collection ~~vessel~~ Vessel (~~V35038~~RLD-VSL-00002)

The RLD system receives ~~radioactive~~ mixed waste effluent from the ~~Melter Offgas Treatment Process System (~~HOP~~)~~ system, the HLW canister decontamination handling system (HDH), and periodic plant and vessel washes within the HLW vitrification plant.

These effluents include the following:~~ submerged bed scrubber purge, wet electrostatic precipitator drain, high efficiency mist eliminator drain, canister decontamination waste, various plant and vessel washes, sump wastes, and miscellaneous radioactive drains, including vessel vent, bulge, and cabinet drains.~~

- Purge liquid from the ~~s~~Submerged ~~b~~Bed ~~s~~Scrubbers (HOP-SCB-00001/2)
- Drains from the ~~w~~Wet ~~e~~Electrostatic ~~p~~Precipitators (HOP-WESP-00001/2)
- Drains from the ~~h~~High-~~e~~Efficiency ~~m~~Mist ~~e~~Eliminators (HOP-HEME-00001A/1B/2A/2B)
- Various plant and vessel washes and sump water
- Miscellaneous ~~radioactive~~mixed waste ~~drains~~streams, including vessel vent,~~ and~~ bulge, and cabinet drains and canister decontamination effluents

~~The functional purpose of the RLD is to handle liquid waste for interim storage and transfer to pretreatment facilities where the waste is either recycled to the process or sent to the LERF/ETF.~~

~~Various operations such as neutralization, mixing, and sampling of the waste are performed by these systems as required.~~

Acidic Waste Vessel (RLD-VSL-00007)

This vessel collects liquid from the ~~submerged~~ Submerged ~~bed~~ Bed ~~scrubber~~ Scrubber (HOP-SCB-00001/2) and the ~~submerged~~ SBS~~bed scrubber~~ eCondensate ~~collection r~~Receiver ~~vessel~~ Vessel (HOP-VSL-00903/4). The collected liquid waste consists of submerged bed scrubber purge, wet electrostatic precipitator drain, and high-efficiency mist eliminator drain. Sampling will be performed ~~via~~ by an automated sample system to characterize the liquid waste. The contents are transferred to the ~~HLW effluent transfer vessel (V12002)~~ PWD system in the pretreatment plant for treatment, as required.

Plant Wash and Drains Vessel (RLD-VSL-00008)

This vessel collects drains from ~~the wet electrostatic precipitators (HOP-WESP-00001/2), and washes from~~ vessels, sumps, and plant washes within the HLW vitrification plant, including wash water from cell ~~walls~~floors, equipment exterior surfaces, stainless steel cladding, and bulges. This vessel also collects the C3 area fire water. Sampling will be performed ~~via~~ by an automated sample system to characterize the liquid waste. The contents are transferred to the ~~HLW effluent transfer vessel (V12002)~~PWD system in the pretreatment plant for treatment, as required.

~~Decontamination Effluent Collection Vessel~~

~~This vessel receives liquid waste from waste neutralization vessel (V33002). Sampling will be performed via an auto sampler to characterize the liquid waste. The contents are transferred to the HLW effluent transfer vessel (V12002) in pretreatment.~~

Offgas Drains Collection Vessel (RLD-VSL-00002)

This vessel receives condensate from the HOP ~~ducts~~ pipes and PJV drains downstream from the ~~h~~High-~~e~~Efficiency ~~mist~~ Mist ~~eliminator~~ Eliminator (HOP-HEME-00001A/1B/2A/2B) during off-normal operation. The contents are transferred to the ~~plant~~ Plant ~~wash~~ Wash and ~~drains~~ Drains ~~vessel~~ Vessel (RLD-VSL-00008) in the HLW vitrification plant for processing.

~~Instrumentation, alarms, controls, and interlocks will be provided for the RLD~~ system ~~to indicate or prevent the following conditions:~~

- ~~Level indication: Level in the vessel is monitored for process condition and status. High level alarm alerts operators to high fill condition. High high level will result in the stop of the incoming transfer. Low level alarm alerts operator to low fill condition. Low low level will result in the stop of outgoing transfer.~~
- ~~Temperature indication: Temperature in the vessel is monitored for process condition and status.~~
- ~~Density indication: Density is monitored for process condition and status. The density is also used to determine the liquid level.~~

- ~~Pressure indicator: Vessel vacuum is monitored to assure contaminated vapor containment. The pressure is also used to determine the liquid level.~~
- ~~Prevent receiving waste when the vessel is at high-high liquid level.~~
- ~~The pump and mixer are cut off at low-low liquid level.~~
- ~~The pump will stop transfer if the destination vessels (in the pretreatment plant or within the HLW vitrification plant) reach high-high liquid level.~~

~~Regulated HLW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.G.~~

~~4.1.4.6~~4.1.4.7 IHLW Glass Canister Handling Process

The IHLW glass canister handling will consist of the following systems:

- HLW canister receipt handling system (HRH) ~~system~~
- HLW canister pour handling system (HPH) ~~system~~
- HLW canister decontamination handling system (HDH) ~~system~~
- HLW canister export handling system (HEH) ~~system~~

The individual systems and their primary functions are described below:

~~4.1.4.6.1~~HLW Canister Receipt Handling System (HRH) ~~System~~

~~The primary function of this system is to import clean canisters into the facility.~~ The HRH system consists of the equipment, controls, and interlocks required for importing a clean canister into the plant. This system consists of the canister import truck bay, the canister import ~~bulge~~room, and the canister import tunnel ~~and the canister transfer interface into the handling cave~~. These areas are located on the south side of the plant.

~~The HRH begins at a truck bay where canisters are first brought within the HLW vitrification plant. An import bulge is located in the truck bay on the north wall and on the south side of the import tunnel. The bulge is intended to provide a separate air space between the C1 truck bay, and the C3 import tunnel during canister import.~~

~~An overhead crane, stationed in the truck bay, will unload shipping canisters from the transport truck. The shipping canisters will be placed in the staging area where receiving personnel will inspect the canister packaging for shipping damage. The crane will then remove an individual IHLW canister from the shipping canister and place it on the inspection/rotation table. The lid will be removed, and both the canister and the lid will be inspected for cleanliness, damage, and compliance with new product canister specifications. The canister identification number is assigned and results of inspection are recorded. Each canister will have a unique identification number that will be entered into the plant tracking system to allow tracking of the canister throughout the plant.~~

~~After the canister inspection, the import bulge roller shutter door will be opened and the table will rotate the canister into the vertical position. This is required before introduction into the canister handling cave because all process sequences are designed to handle a vertical canister. The canister lid will be replaced and the overhead monorail hoist and grapple will grab and support the canister while being released from the table. The monorail will lift and transfer the canister into the import bulge. The canister will either be set in the import buffer racks or placed in the import bogie. When the canister is transferred to the import tunnel, the sealed hatch is opened and the canister is lowered into the import bogie below. Once the canister is loaded into the bogie, the grapple is released and withdrawn and the hatch is closed. The bogie is transferred to the canister handling cave. The canister handling cave's shielded hatch is then opened and the canister handling cave crane raises the canister into the canister handling cave. The hatch is closed and the canister is taken to the canister handling cave buffer storage area rack. The canister identification number will be logged in the plant information network as being entered into the process.~~

The sequence of operations and the equipment used for canister import are as follows:

- The shipping crates are unloaded from the transport truck with the canister import crane and ~~horizontal canister grapple and~~ placed in the staging area.
- The canisters are then individually removed from the shipping crate ~~with the horizontal canister grapples,~~ and set on the canister inspection/rotation table.
- The canister import room roller shutter door is opened and the canister inspection/rotation table rotates the canister to vertical. The canister import monorail hoist and grapple lift and transfer the canister to the canister import room. The canister is either set in the canister import buffer rack or placed in the canister import bogie. When the canister is transferred to the canister import tunnel, the shielded clean canister import hatch is opened and the canister is lowered into the canister import bogie below, and the hatch is closed and sealed.
- The canister import bogie is transferred under the canister handling cave to the shielded canister handling cave import hatch location. The canister handling cave hatch is then opened and the canister handling cave crane and grapple raises the canister into the canister handling cave. The canister handling cave import hatch is closed and the canister import bogie is returned to under the clean canister import hatch.

Instrumentation, alarms, controls, and/or interlocks will be provided for the HRH system as follows:

~~□Sealed hatch will be interlocked with the shielded hatch~~

~~□Personal access door to import tunnel will be interlocked with gamma monitors~~

- ~~Shielded~~ Sealed hatch will be interlocked with canister import room roller shutter door preventing back-flow of C3 air into canister import room or truck bay
- Prevent rotation/inspection table from rotating when roller shutter door is closed

~~□The import tunnel sealed door is interlocked with the import hatch~~

- ~~System~~The HRH system will be designed such that only one door or hatch will be open at any one time
- ~~Provide g~~Gamma interlock will be provided to prevent shielded personnel access door in canister import tunnel from being opened when radiation/contamination levels exceed limits or if the canister handling cave import hatch is open
- ~~Provide g~~Gamma interlock will be provided to prevent clean canister import hatch in the canister import room from being opened when radiation/contamination levels exceed limits or if the canister handling cave import hatch is open

~~4.1.4.6.2~~HLW Canister Pour Handling System (HPH)~~ System~~

The primary functions of the~~system~~ HPH system are to transport empty product canisters and full IHLW canisters within the plant and perform product canister sampling, canister closure, and canister rework activities. ~~System~~ The HPH system includes the canister handling cave, which includes two weld stations. The crane decontamination and crane maintenance areas are also part of ~~system~~the HPH system, located west of the canister handling cave. Pour tunnels no. 1 and no. 2, which includes the bogie decontamination and maintenance areas, are also part of this system.

The primary functions of this system are to provide equipment to the transport canister, provide equipment for decontamination and maintenance, and ~~to~~ provide equipment for remote viewing.

The primary functions of ~~this system~~the canister handling cave are as follows:

- ~~Transport IHLW canisters between the canister handling cave and melter pour station~~
- ~~Provide a transfer router for secondary waste and equipment for decontamination and maintenance~~
- ~~Transport IHLW empty and filled canisters to interfacing process systems~~
- ~~Provide cooling buffer storage prior to welding~~
- ~~Provide lag storage prior to canister decontamination~~
- ~~Staging empty canisters for filling and full canisters for cooling~~
- ~~Provide buffer storage of canisters~~
- ~~Crane decontamination and maintenance~~
- ~~Export of consumables~~
- ~~Prepare IHLW canisters for welding~~
- ~~Weld canister lids~~
- ~~Provide glass shard sampling~~
- ~~Inspect canisters~~
- ~~Rework defective welds~~
- Receive canister from ~~system~~ HRH system canister receipt handling
- Transport empty canister to import racks
- Transfer empty canister to pour tunnel 1 or 2

- Receive full canister from pour tunnel 1 or 2
- Transport full canister to cooling rack
- Transport canister to weld station
- Transfer canister to ~~system~~ HDH system canister decontamination handling
- Provide equipment for canister import and buffer store

This section ~~focuses primarily on Pour Tunnel 1; however, Pour Tunnel 2 will be utilized to support a second melter, as necessary. The equipment for Pour Tunnel 2 will be similar to that provided for Pour Tunnel 1 but will be installed later to support the second melter~~describes activities that will be performed in HLW pour tunnel no. 1 (H-B032) and pour tunnel no. 2 (H-B005A).

Pour Tunnels
The pour tunnels are ~~located south of the melter caves and run in the north-south direction. The bogie and rails extend further under the melter cave under the melter allowing a standby bogie to be positioned under the melter when the process bogie is in the pour position. The rails will be isolated from the melter cave with steel contamination control barriers. The bogie decontamination areas are located south of the melter caves. Viewing windows and master-slave manipulators are provided for each bogie~~at the -21 ft level and extend from north-south beneath the south end of the melter cave to an area below the canister handling cave. Bogie decontamination is performed in the tunnels, and bogie maintenance areas are provided in a designated shielded area at the south end of the tunnels. The tunnels will have a hatch that segregates the pour tunnels and the canister handling cave. The tunnels will also have a bogie maintenance shield door. The bogie maintenance area has a shield personnel access door and a roof access plug from the corridor above. The pour tunnels are designated as C5 areas.

When a canister is required for filling, it is taken out of the buffer rack in the canister handling cave using the canister handling cave crane and transferred above the appropriate pour tunnel hatch. The hatch is opened and the canister handling cave crane loads the empty canister ~~into~~ onto the pour tunnel bogie. The ~~grapple is released and raised and the hatch is closed. The~~ bogie travels north to the ~~lidding device. At the lidding device, the primary bogie moves up to the standby bogie and latches onto it. The primary bogie is then in~~pouring position ~~with the lid removed. The standby bogie is shunted along the track until the primary bogie is in position under the pour spout. The primary bogie is then in position, the pour spout is lowered onto~~The canister is positioned below the pour spout, connected to the canister flange, and the canister is filled with glass. ~~Canister filling is controlled and monitored by the canister level detection system.~~

After completion of filling, the canister remains at the pour spout for approximately one hour to allow a "skin" to form over the glass ~~which~~ that provides a seal to prevent additional offgassing~~.~~ ~~The pour spout is then retracted and the primary bogie is unlocked, and moved back. This sequence also moves the stand-by bogie back under the pour spout.~~ The filled canister is allowed to cool prior to removal from the pour tunnel. ~~The primary bogie is then unlatched from the standby bogie and~~After cooling, the canister is moved south in the pour tunnel until it is beneath the canister handling cave hatch. The hatch is opened, the canister handling cave crane removes the full canister, and the hatch is closed. The filled canister is then cooled in cooling racks in preparation for welding the lid in place.

Canister Transport

~~System~~ The HPH system supports both HLW ~~m~~Melters (HMP-MLTR-00001/2). ~~HLW~~ ~~c~~Canisters are transported within the canister handling cave by means of an overhead crane. A standby crane is available in the event of the primary overhead crane failure. Viewing windows and camera are provided for viewing of equipment and operations within the cave area. Integrated networks of programmable logic controllers, which form part of the ~~PCS~~process control system, are used to control the mechanical handling.

~~The c~~Clean canisters ~~is~~ are transferred from ~~the system~~ the HRH system to ~~the system~~ the HPH system through the canister import tunnel hatch. The hatch opens and the handling cave crane raises the canister into the canister handling cave. The hatch is closed and the canister is taken to the buffer storage area racks. When a canister is required for filling, it is taken out of the buffer rack using the canister handling cave crane and transferred above the appropriate pour tunnel hatch. The hatch is opened and the canister is lowered into the pour tunnel bogie below. The grapple is released and raised and the hatch is closed. The bogie travels to a position under the pour spout. As the bogie moves into position under the pour spout, the pour spout glass catch tray is pushed back and signals that a canister is present. A proximity switch detects that the bogie is in position, the bogie is then locked into position, and the canister is filled with glass. Canister filling is controlled and monitored by the canister level detection system (system HMP melter process). After the canister is filled with glass, the crane located above the hatch transfers the filled canister to the ~~buffer/~~cooling rack where it is allowed to cool. After cooling, a crane transfers the canister for lid welding, sampling of glass, and/or rework. The canister is lowered into the welding station table and the grapple released from the canister. After the welding station operations, the crane transfers the canister ~~back~~ to the ~~cooling~~ buffer storage racks or to the decontamination system rinse bogie, via the decontamination hatch.

The canister handling cave is classified as a C5 area; therefore, ~~most~~ activities in the handling cave will be ~~handled~~ conducted remotely. This will be accomplished with viewing windows, cameras, manipulators, and overhead cranes. Windows are strategically located above the transfer hatches for viewing the canisters as they are raised and lowered. The crane decontamination area is located on the west end of the canister handling cave. The decontamination area is classified as a C~~5~~3/C~~3~~5 area. The crane maintenance area is located west of the crane decontamination area. The crane maintenance area is classified as a C3 area.

Canister Weld, Glass Sampling, ~~&~~ and Rework

The following system supports both HLW ~~m~~Melters (HMP-MLTR-00001/2). The canister lid welding, glass sampling, canister inspections, and rework will be performed at one of two welding ~~tables~~ stations located along ~~one~~ the south wall ~~in~~ of the canister handling cave. ~~Only one table will be set up with equipment initially, but the second table may be outfitted identically to the first table to support a second melter at a later date~~. Each ~~table will be set~~station is located next to a shield window. Master-slave manipulators, closed circuit television, and lights ~~will be~~are provided ~~when they are required for operations~~to assist weld station operations.

After the canister is cooled in the canister handling cave, the overhead crane moves the canister from the cooling rack into a port on the welding table. The canister is weighed and confirmed to be below the maximum allowable weight. While the canister is being lowered, cameras inspect the outside of the canister. Typically, glass waste residue is not expected on the exterior of the canister. However, prior to welding the lid on the canister, the canister is inspected. If glass is found on the canister, the glass will be removed using a needle descaler manually operated with the master-slave manipulator. A vacuum system will be used to capture the removed glass and prevent the spread of debris. The canister is then checked to confirm that its temperature is within the allowable range for welding. This is done using a thermocouple at the weld station~~.~~ ~~Then the lid is removed using a lid lifter, and required inspections, such as glass fill height or foreign debris inside the canister, are performed~~. Glass samples are collected using a~~n~~ master-slave manipulator-operated glass sampling tool that uses a vacuum to draw shards of glass from the top surface. These shards are then transferred into sample vials and transferred to the laboratory using a pneumatic transfer system.

The lid is placed on the canister and welding is performed using an automated welder~~. The welding torch has an arc voltage controlled head and the ability to remotely control the torch angle, travel speed, and travel direction~~. The welding parameters are recorded in the plant tracking system. The finished weld is visually inspected using in-cave inspection cameras. Rejected welds may be repaired by re-melting the weld, mechanically removing the weld and re-welding, or welding a secondary lid over the primary lid~~. Metal dust and slag resulting from rework will be removed using a localized HEPA vacuum to minimize the spread of contamination~~. The sealed canister is then transferred to ~~the HLW Canister Decontamination Handling Ssystem~~the ~~(~~HDH~~)~~ system.

Instrumentation, alarms, controls, and interlocks will be provided for the ~~I~~HLW canister handling system to indicate or prevent the following conditions:

- ~~Zone controls will be employed on the HPH crane to prevent the canister from impacting the welding station during canister transfers. An interlock on the crane will prevent the crane from coming into position over the canister port in the table unless the weld station carriage is positioned out of the way for this movement.~~
- ~~Carriages will not move when the equipment mounted on the frame is deployed or in operation.~~
- The crane decontamination shield doors ~~is~~ are interlocked with the crane maintenance shield door to prevent both sets of doors from being open ~~concurrently~~simultaneously.
- ~~The shielded door in the crane maintenance area is interlocked with the crane maintenance shield door. The door is also interlocked with a gamma monitor to prevent opening when a dose is present.~~
- Interlocks will prevent the inadvertent access of personnel or equipment movement

- ~~Process cranes are interlocked such that their hoists can only be lowered at designated positions in automatic mode, and if over hatches, when signal confirms door is in open position.~~
- ~~Process cranes are interlocked with the hoists such that the cranes can only move with the grapple at transport height.~~
- ~~The process cranes are interlocked such that they cannot attempt to enter the crane decontamination area unless the crane decontamination shield door is open.~~
- The bogie maintenance shield door is interlocked with the shielded personnel access door to ensure that personnel do not enter the bogie maintenance area when the bogie maintenance shield door is open.
- Radiation monitoring equipment is interlocked to the shielded personnel access door to ensure no personnel are able to access the maintenance area if a radiation/contamination source above prescribed limits is present.
- ~~The bogie sleeve detector is interlocked to the bogie maintenance shield door to ensure the sleeve is removed from the bogie before the bogie enters the maintenance area.~~
- ~~An interlock with ensure that the canister lid has been removed before glass filling can take place.~~

HLW Canister Decontamination Handling System (HDH)
Figure 4A-30 presents a simplified process flow diagram of the HLW canister decontamination handling system (HDH). The primary function of this system is to decontaminate the IHLW canisters~~,~~ and to swab and monitor IHLW canisters~~, and decontaminate the HDH equipment~~.

The HDH system includes the process and equipment to perform the cerium nitrate canister decontamination process, surface swabbing, and swab monitoring process. The following vessels and their associated ancillary equipment are included in the HDH system:

- ~~Canister rRinse bBogie dDecon vVessel~~Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001)
- Waste ~~n~~Neutralization ~~v~~Vessel (HDH-VSL-00003)
- Canister ~~d~~Decon ~~v~~Vessels (HDH-VSL-00002/4)

~~The IHLW canister will be managed above floor level in the decontamination cave and below floor level in the rinse and transfer tunnels either on a bogie or suspended by crane.~~

The HDH system consists of a canister rinse tunnel, canister decontamination station, swabbing and monitoring station, bogie maintenance areas, crane maintenance area, and canister transfer tunnel~~. The decontamination station is located in front of a viewing window~~. The decontamination system consists of two stations: the decontamination station, which is located in-cave, ~~(canister decontamination vessel, waste neutralization vessel, and two breakpots to waste neutralization tank)~~ and a mixing station, ~~(including nitric acid addition tank, cerium addition tank, and hydrogen peroxide addition pot)~~ which is located out-cave. Vertical separation between the stations facilitates gravity flow of process solutions from the mixing station to the ~~c~~Canister ~~d~~Decon~~tamination vessels~~ Vessels (HDH-VSL-00002/4). Beneath the canister decon~~tamination~~ cave is a canister rinse tunnel and a canister storage transfer tunnel. The canister rinse tunnel ~~includes a bogie decontamination and maintenance area and~~ houses the canister rinse bogie, which transfers the canister from the canister handling cave to the canister decon~~tamination~~ cave while performing a prewash at an intermediate station. The canister storage transfer tunnel houses the canister storage transfer bogie, which transfers the decontaminated canisters from the canister decon~~tamination~~ cave to the canister ~~storage~~ export cave.

A filled, cooled, and welded IHLW canister is initially transported to ~~the system~~the HDH system via a crane located in the canister handling cave. The IHLW canister is loaded ~~onto~~ into the canister rinse bogie~~,~~ and washed in a sealed ~~area~~ vessel using low-pressure demineralized water to remove loose contamination. This water wash is performed in ~~a container~~ the ~~c~~Canister ~~r~~Rinse ~~b~~Bogie ~~d~~Decon ~~v~~Vessel (HDH-VSL-00001) mounted on the canister rinse bogie, which travels from below the canister handling cave to below the canister decon~~tamination~~ cave. After the water wash, the canister is transferred by a crane to the canister decon~~tamination~~ vessel for further decontamination by chemically etching a thin layer of stainless steel from the canister surface, using cerium ion in a dilute nitric acid. The canister is then washed with nitric acid, followed by a second washing with de-~~ionized~~ mineralized water. After draining de-mineralized water from the ~~c~~Canister ~~d~~Decon ~~v~~Vessel (HDH-VSL-00002/4), the canister remains in the vessel to dry.~~, while~~ ~~t~~The decontamination fluids are pumped into a ~~w~~Waste ~~n~~Neutralization ~~vessel~~ Vessel (HDH-VSL-00003) to which hydrogen peroxide is added to neutralize remaining cerium ion. Following neutralization, the fluid is transferred to the plant waste stream, ~~and it can be~~or recycled back into the HLW ~~melters~~ Melters via the pretreatment plant. The decontaminated canister is transported by overhead crane to the canister swabbing and monitoring area.

After decontamination and drying, the canister is swabbed using an automated power manipulator. If the contamination is below acceptable limits, the IHLW canister is placed into a canister storage transfer bogie located below the canister decon~~tamination~~ cave floor, and transported to the HLW canister export handling system~~. IHLW canisters that exceed the contamination limits are returned to the decontamination and swabbing station for further processing. Swabbing and monitoring results are recorded~~.

In addition to the ~~i~~Instrumentation, alarms, controls, and interlocks addressed in section 4.1.4, the following will be provided in for the HDH system to indicate or prevent the following conditions:

- Interlocks will be provided on bogie decontamination/maintenance area shield door to protect plant personnel from radiation and contamination exposure.
- Interlocks will be provided on crane maintenance area shield door to protect plant personnel from contamination exposure.

~~Regulated HLW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.G.~~

HLW Canister Export Handling System (HEH) ~~System~~

The primary functions of this system are to ~~provide storage of the~~store filled IHLW canisters in ~~storage~~ racks, transfer the IHLW canisters into the canister ~~storage~~ export cave, load the IHLW canisters ~~onto~~ into product casks, evaluate product casks for contamination, and load IHLW product casks into transport vehicles. ~~The System~~The HEH system consists of a canister ~~storage~~ export cave, a cask handling tunnel, a cask loading area, and a truck bay, and is equipped to support both HLW ~~m~~Melters (HMP-MLTR-00001/2).

~~The d~~Decontaminated IHLW canisters are transferred to the canister ~~storage~~ export cave from ~~the system~~ the HDH system using a bogie and an overhead crane and placed in the canister storage racks. When a IHLW canister is ready for exporting to an appropriate Hanford Site TSD unit, a dedicated transport vehicle is dispatched to the IHLW truck bay. The empty product cask is removed from the vehicle and placed on a cask transfer bogie located in the cask handling tunnel. The bogie transfers the cask to a lid lifting station where the lid is removed, and then to a canister receiving station. The IHLW canister is visually inspected in the canister storage cave and its identification confirmed. After the inspection information is recorded, the canister is lifted by overhead crane and placed into the product cask. The bogie then returns the cask to the lid lifting station where the lid is replaced and bolted. The product cask is then transferred to the export station where the cask is lifted by an overhead crane and placed on the transport vehicle. Swab samples are taken, and when the cask exterior is verified to be below the acceptable radioactive contamination level, the cask is transported to a Hanford Site storage facility.

Closed circuit television cameras will provide general viewing of the canisters and the storage area. Descriptions of inspections of IHLW canister storage areas are included in Chapter 6 of this ~~application~~permit. An IHLW canister tracking system will retain required information such as the IHLW identification number, weight, and dimensions of the IHLW canisters.

In addition to the ~~i~~Instrumentation, alarms, controls, and interlocks addressed in section 4.1.4, the following will be provided for the HEH to indicate or prevent the following conditions:

- Interlocks to prevent the canister storage cave import hatch and the canister storage cave export hatch from being open at the same time
- Gamma monitoring and keyed interlocks to prevent the cask export hatch from opening when high radiation levels exist
- ~~Interlock to prevent cask handling crane movements into the truck bay unless the truck bay inner roller shutter door is open~~
- ~~Interlock to prevent the truck bay inner roller shutter door closing if the hoist/cask is in danger zone~~
- ~~Interlock to prevent cask handling bogie travel to canister storage cave export hatch unless the cask lid is removed and the cask export hatch is closed~~
- Interlock to prevent the canister storage cave export hatch from being open at the same time as the cask export hatch

- ~~Interlock to prevent hoist lowering cask onto the cask handling bogie unless the cask export hatch is open and the cask handling bogie is in place and locked in position with the bogie location bolt~~
- ~~Interlock to prevent hoist lowering canister into cask unless the canister storage cave export hatch is open and the cask handling bogie is in place and locked in position with the bogie location bolt~~
- Gamma detectors/interlock to prevent cask handling bogie travel to the cask export hatch unless the cask lid is properly installed
- Interlock to prevent both truck bay "exit" and "entrance" (external) roller shutter doors from being open at the same time
- Interlock to prevent the truck bay inner roller shutter door from being open at the same time as either of the "exit" or "entrance" roller shutter doors
- The shielded personnel access door in the canister export cave crane maintenance area is interlocked with the canister export cave crane maintenance horizontal and vertical shield door. The shielded personnel access door is also interlocked with a gamma monitor to prevent opening when a source is present.
- The canister export cave import hatch is interlocked to prevent opening unless the following conditions are satisfied. The canister export cave export hatch is closed. The crane maintenance area shield horizontal and vertical shield doors are closed. The decontamination cave export hatch is closed. The canister storage transfer bogie is in position under the canister export cave import hatch.
- The canister export cave export hatch is interlocked to prevent opening until the following conditions are satisfied. The canister export cave import hatch is closed. The cask export hatch is closed. The cask handling bogie is under the canister export cave export hatch. The cask handling tunnel shielded personnel access door is closed.
- The process crane is prevented from striking the crane maintenance area shield door by end of travel and over–travel limit switches.

~~4.1.4.7~~4.1.4.8 HLW Melter Cave Mechanical Systems

Each HLW melter cave mechanical systems will consist of the following individual systems:

- HLW melter handling system (HMH) ~~HLW Mmelter cCave sSupport Hhandling sSystem (HSH) System~~
- ~~HLW Filter Handling (HFH)~~
- ~~HLW Mmelter Hhandling sSystem (HMH)~~HLW melter cave support handling system (HSH) ~~System~~
- ~~Radioactive Solid Waste Handling (RWH) System~~

The individual systems and their primary functions are described below:

HLW Melter Handling System (HMH)

The primary function of the following system is identical for both Melters (HMP-MLTR-00001/2). The HMH system provides the equipment and controls necessary to:

- Transport new melter units into the HLW melter cave in conjunction with the HSH system
- Remove spent melter units from the HLW melter cave
- Decontaminate and monitor the spent melter overpacks

A multi-axle transporter will be used to move a new overpacked HLW Melter to the HLW vitrification plant loading dock. The overpacked melter will be offloaded, transferred through the rollup doors to the melter cave airlock, transferred through the airlock, and docked to the melter cave shield door. After opening the shield and overpack doors, the melter will be moved out of its overpack and installed in the melter cave.

The process of removing a spent HLW Melter from a cave and loading it back into its overpack is the reverse of the installation. The overpack will provide a shielded disposal/storage container for the spent melter. After the outside surfaces of the overpack have been checked for radiological contamination and decontaminated as required, the spent melter and its overpack will be moved through the melter airlock through the rollup doors and placed on the transporter, to be moved out of the HLW vitrification plant.

Decontamination of the overpack in the C3/C5 airlock, before it is exported, will be performed manually using moist cloths. The HLW Melter overpack's primary function is to serve as a shielded, box-like enclosure for the storage, transport, and disposal of the HLW Melter. The overpack performs a radiological shielding function of the highly radioactive spent HLW Melter. Due to the high radiation levels associated with a spent HLW Melter, the walls on all sides of the HLW Melter overpack will be seal-welded and have a nominal thickness of approximately 8 in. of carbon steel. The estimated weight of the HLW Melter overpack is 250 tons with an empty melter, and 350 tons when carrying a payload of the HLW Melter full of glass. The spent Melter weight when full of glass is a worst case in the event that the residual glass removal described in section 4.1.4.7 cannot be performed. After 3 to 5 years of service, an HLW Melter is expected to reach the end of useful life service, and will be placed in the overpack before removing it from the HLW vitrification plant. The overpack, with the spent HLW Melter inside, will be moved to the HLW failed melter storage facility prior to land disposal. The overpack will be disposed at the Hanford Site if it meets the low-level waste definition and the land disposal facility waste acceptance criteria.

Justification for on-site burial of the 8 in. carbon steel overpack results from a corrosion study of submarine reactors based on chemical content, resistivity, aeration, and burial methods. The predicted maximum pitting corrosion penetration for a 100-year period was 0.350 in. for reactors buried in geologic conditions similar to those in which the overpacks will be buried. (*Prediction of Pitting Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington, March 1992*).

Prior to disposal, the spent Melter will be stored in the failed melter storage facility. If a Melter fails to meet the receiving TSD waste acceptance criteria, it will be stored until the HLW vitrification plant operating conditions are suitable for the spent melter to be returned to the melter cave for further decontamination, treatment, repackaging, and/or other process to enable the spent melter to meet the receiving facility's waste acceptance criteria.

HLW Melter Cave Support Handling System (HSH) ~~System~~

The primary function of this system is to provide remotely operated equipment to perform these support activities in ~~the~~ each melter cave:

- Melter maintenance and replacement
- Melter component and consumable maintenance and replacement
- Melter component and consumable dismantling, sorting, and loading
- Equipment decontamination and hands-on maintenance

Decontamination ~~t~~Tanks (HSH-TK-00001/2) and associated ancillary equipment are included in the HSH system.

~~The~~ Each melter cave will contain ~~the~~ an HLW ~~melter~~ Melter (HMP-MLTR-00001/2), ~~melter feed~~ Feed ~~preparation~~ Preparation Vessels (HFP-VSL-00001/5), and HLW Melter ~~f~~Feed ~~vessels~~ Vessels (~~HFP-VSL-00001/5 and~~ HFP-VSL-00002/6~~, respectively~~), and ~~certain~~ the following offgas system components~~.~~:

- Film ~~c~~Coolers (HOP-FCLR-00001/2)
- Submerged ~~b~~Bed ~~s~~Scrubbers (HOP-SCB-00001/2)
- High-~~-~~ ~~e~~Efficiency ~~m~~Mist ~~e~~Eliminators (HOP-HEME-00001A/1B/2A/2B)

Overhead cranes, hoists, and master-slave and power manipulators will be the primary equipment used to carry out various replacement, size reduction, and packaging tasks. Auxiliary tools will include impact wrenches, nut-runners, and hydraulic shears.

In addition, the HSH system will provide the means to dismantle and reduce the size of spent melter components or consumables for export out of the cave in waste containers. Various size reduction tools will be used to cut down the equipment. The waste will be placed on a sorting table for screening and segregation prior to packaging and export.

~~Melter replacement will generally be preceded by an alternate glass removal step~~Prior to Melter replacement, residual glass will normally be removed from a spent Melter. Lid heaters will keep the glass pool at the desired temperature ranges. Air and vacuum lines will be inserted to draw the molten glass into ~~an attached~~ canister. The ~~failed~~ spent ~~melter~~ Melter will then be disconnected and prepared for transport out of the cave.

A consumable bucket, equipped with interchangeable lid cutouts called templates, will be used to import and export melter consumables. ~~HLW Melter Feed Process System~~The HFP vessels will be organized such that power manipulators can disconnect connections and prepare failed vessels and components for export. Components of the HOP system found in this cave will also be organized for similar activities.

The HSH system will provide a ~~crane d~~Decontamination T~~room above~~tank (HSH-TK-00001/2) in the ~~C3/C5 airlock~~equipment decontamination area, to allow for decontamination of consumables and equipment before hands-on maintenance in the crane maintenance area. In the decontamination ~~room~~tank, the ~~crane and~~ equipment will be ~~decontaminated with~~soaked in ~~a~~ demineralized ~~high pressure wash~~ water ~~spray. Non-organic detergents or acid solvents may also be used, if needed. Wash water will be collected by a sump~~and/or nitric acid. The equipment decontamination area will be used to additionally decontaminate equipment using manipulators before items can be removed for hands-on maintenance. A crane decontamination area is located above the C3/C5 airlock.

~~Regulated HLW vitrification plant tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.G.~~

~~4.1.4.8~~4.1.4.9 HLW Filter Handling System (HFH)

~~The primary function of this system is to provide the equipment and controls necessary for:~~

- ~~Filtration of process area exhaust air~~
- ~~Service, repair, and replacement of filters~~
- ~~Size reduction and packaging of spent filters~~

~~The HFH will house the equipment that provides C5 filtration for the HLW vitrification plant. Located within the filter cave will be the HVAC HEPA filter banks, HLW melter offgas HEPA preheaters, HLW melter offgas HEPA filters, and ancillary equipment and instrumentation.~~

~~Spent equipment and consumables will be moved into and out of the filter cave using bogies and Cranes. power manipulators and hoists will facilitate the movement of equipment within the filter cave. Shield doors will form a radiological barrier between the cave and the overhead crane maintenance area. The filter cave will be equipped with closed circuit television.~~

~~A power manipulator will be used for interfacing directly with filter lids, dampers, and elements during replacement of HEPA filters. Spent filters will be placed into a disposal basket at the filter compactor. A two stage compact telescopic cylinder compresses the filter into the basket sized to fit inside a waste container on top of a drum transport bogie. Once the basket is full, it will be loaded into the drum and transported to the radioactive solid waste handling (RWH). Spray wash nozzles above the crane's locked position and a spray cabinet for the power manipulator will be used to ensure that the equipment is maintained in an uncontaminated state.~~

The filter cave is at grade level west of the melter cave 2. The walls, ceiling, and floor of the filter cave are of reinforced concrete. The filter cave contains the spent filter export hatch, which interfaces with the drum transfer tunnel. Gross decontamination of filter cave equipment will be performed here. The filter cave also contains a pair of shield doors at the interface between the filter cave and the maintenance area. The shield doors provide the ~~radiological~~ barrier between the filter cave and the man-accessed maintenance area. The filter cave is designated as a C5 area.

The C5 filter system in the filter cave will consist of three two-stage HEPA housings (one for melter cave no. 1, another for melter cave no. 2, and one for the canister handling cave and the filter cave itself). In addition, there will be two HEPA ~~f~~filter housings for each melter offgas and PJV systems.

The filter housings will be of stainless steel. The filter lids will be flush with a stainless steel clad false floor (filter cave deck) that covers the entire cave at 14 ft elevation. The following equipment will be used for replacement of HEPA ~~f~~Filters and with other in-cave activities.

- Filter compactor
- Power manipulators
- Crane and cable reeling system
- Spent filter export hatch

~~4.1.4.9HLW Melter Handling System (HMH) System~~

~~The primary function of this the following system is identical for both melters (HMP-MLTR-00001/2) will be to . The HMH system provides the equipment and controls necessary to:~~

- ~~□Transport new melter units into the HLW melter cave in conjunction systemwith the HSH system~~
- ~~□Remove spent melter units from the HLW melter cave~~
- ~~□Decontaminate and monitor the spent melter overpacks~~

~~A multi-axle transporter will be used to move a new overpacked HLW melter from the melter assembly building to the HLW vitrification plant loading dock. The overpacked melter will be offloaded, transferred through the rollup doors to the melter cave airlock, transferred through the airlock, and docked to the melter cave shield door. After opening the shield and overpack doors, the melter will be moved out of its overpack and installed in the melter cave.~~

~~The process of removing a spent HLW melter from the a cave and loading it back into its overpack is the reverse of the installation. The overpack will provide a shielded disposal/storage canister container for the spent melter. After the outside surfaces of the overpack have been checked for radiological contamination and decontaminated as required, the spent melter and its~~

~~overpack will be moved through the melter airlock through the rollup doors and placed on the transporter, to be moved out of the HLW vitrification plant through the rollup doors.~~

~~Decontamination of the overpack in the C3/C5 airlock, before it is exported, will be done performed manually using moist cloths. Water spray will also be provided as a contingency. The airlock will have a sump to collect decontamination water. The HLW melter overpack's primary function is to serve as a shielded, box-like enclosure for the storage, transport, and disposal of the HLW melter. The overpack performs a radiological shielding function of the highly radioactive spent HLW melter. Due to the high radiation levels associated with a spent HLW melter, the walls on all sides of the HLW melter overpack will be seal welded and have a nominal thickness of approximately 8 in." of carbon steel. The estimated weight of the HLW melter overpack is 250 tons when empty, and 350 tons when carrying a payload of the HLW melter - full of glass, weighing approximately 100 tons. This spent melter weight is a worste case in the event that the residual glass removal described in section 4.1.4.7 cannot be performed. After 3 to 5 years of service, an HLW melter is expected to reach the end of useful life service, and will be placed in the overpack before removing it from the HLW facility. The overpack, with the spent HLW melter inside, will be moved to the HLW failed melter storage facility prior to land disposal. The overpack will be disposed at the Hanford Site if it meets the low-level waste definition and the land disposal facility waste acceptance criteria.~~

~~Justification for on-site burial of the 8" in. carbon steel overpack results from a corrosion study of exhumed submarine reactors based on chemical content, resistivity, aeration, and burial methods. The predicted maximum pitting corrosion penetration for a 100 -year period was 0.350 in." for reactors buried in geologic conditions similar to those in which the overpacks will be buried. (*Prediction of Pitting Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington, March 1992*).~~

~~Prior to disposal, the spent melter will be stored in the HLW out-of-servicefailed melter storage facility. If a melter fails to meet the receiving TSD waste acceptance criteria, it will be stored until the HLW vitrification plant operating conditions are suitable for the failed spent melter to be returned to the melter cave for further decontamination, treatment, repackaging, and/or other process to enable the spent melter to meet the receiving TSDfacility's waste acceptance criteria.~~

4.1.4.10 Radioactive Solid Waste Handling System (RWH) ~~System~~

The following system supports both HLW ~~m~~Melters (HMP-MLTR-00001/2) and the HLW filter cave. The primary functions ~~of this system~~ are to:

- Provide containers for removal of miscellaneous solid waste from the HLW melter cave and filter cave
- Transport filled and empty waste containers
- Provide external radiological monitoring of waste containers
- Decontaminate waste containers as required

~~□Assay waste containers to determine radiological inventory~~

- Supply and load waste containers into transport casks
- ~~Transfer casks to the central waste storage facility~~

~~At both the filter cave and the melter cave, the drum will be positioned under the filter cave/ melter cave export well and the drum transfer bogie will be locked into position. The containment between the filter cave/melter cave, and the drum transfer tunnel will be maintained by an engineered air gap between the top of the drum and the underside of the export well. A loaded basket will then be lowered into the drum, using the filter cave/melter cave handling equipment. The drum will then be lowered and transferred to the drum lidding station, where the outer lid will be replaced and crimped onto the drum.~~

~~One of the main functions of the RWH is to transport waste containers between the plant operating area and the swabbing and monitoring area within the RWH. Prior to transporting to the central waste storage area, the sealed drums will be swabbed for contamination along their bottom, sides, and lid interface. Viewing windows will be positioned to allow for the evaluation of the swabbing process. The swabs will be monitored for radiological contamination in an external glovebox. If surface contamination exceeds the accepted limits, the drum will be repeatedly vacuum cleaned, swabbed, and washed with wet swabs until the radiological limits have been met. Drums will be transported by means of an overhead bridge crane and drum grapple. The drums will be lowered through the swabbing and monitoring system floor hatch into an open transport cask. The cask lid will be replaced and the cask will be monitored for gamma radiation shine paths before it is transferred to the import/export area by means of the cask transfer bogie. The cask will then be transferred to the truck bay by an overhead crane for shipment to the central waste storage area.~~

The ~~System~~ RWH system consists of three major operational areas: the drum transfer tunnel, the swabbing and monitoring area, and the cask handling area. ~~Radioactive solid~~Mixed waste is generated in melter caves 1 and 2, the canister handling cave, and the filter cave. ~~RSW~~Mixed waste generated in the canister handling cave is transferred to either melter cave via the pour tunnels and then exported from the melter caves to the drum transfer tunnel. The drum transfer tunnel runs beneath these areas and provides a common area for receipt of waste to consolidate the separate waste streams into a single export path. ~~System~~The RSW system receives waste from ~~system~~the HSH system (melter caves 1 and 2) and ~~system~~the HFH system (filter cave) contained in lidded waste baskets that are lowered through the transfer ports in the ceiling of the drum transfer tunnel.

~~System~~The RWH system introduces empty 55-gallon drums into the HLW ~~facility~~plant~~,~~ for packaging RSW for disposal. Empty 55-gallon drums are placed into shielded casks in the canister export truck bay. The cask is transferred on the cask transport vehicle into the cask import/export area for ultimate transfer from the plant.

The cask is positioned under the monorail hoist. It is then lifted, transferred to, and positioned onto the cask transfer bogie. A shield door is opened and the bogie is moved to the cask lidding station. The cask lid pintle is aligned with the lifting claw of the cask lidding machine and the cask lid is removed. The cask is then positioned under the cask transfer hatch. The drum, lid, and clamping ring are imported into the swabbing and monitoring area and manually staged on a stand in front of the shield window.

The drum transfer bogie rolls to position beneath a transfer hatch of either melter cave no. 1, melter cave no. 2, or the filter cave. With the drum positioned under the selected cave transfer port, a loaded waste basket is lowered into the drum by the interfacing cave system's crane and grapple. With the basket located in the drum, the grapple is detached and raised by the system crane. The full 55-gallon drum is relocated back to the position under the drum transfer hatch to the swab and monitoring area. The drum is lifted into the swab and monitoring area using the overhead crane and drum grapple.

~~System~~The RWH system transports loaded drums into the lidding, swabbing, and monitoring area for lidding, swabbing, external monitoring, and decontamination (if required). The system then exports the filled 55-gallon drums through the import/export area.

The following operations are performed:

- The crane lifts the drum to the swabbing and monitoring station. Two master-slave manipulators will be mounted on the wall of the swabbing and monitoring area and will provide the operator interface for installation of the drum outer lid and clamping ring while the drum is positioned on the drum turntable.
- The robotic swabbing arm and turntable swab the surface of the drum. The swabs are placed in the shielded posting of the swab analyzing station. Following preliminary measurement of the swab, the posting port is actuated to move the swab into the swabbing and monitoring glovebox where the sample is analyzed and bagged out for disposal.
- If the swabs are within acceptable limits, the crane lifts the drum from the drum swabbing turntable and positions the drum over the cask transfer hatch and places it in the shielded cask on the cask transport bogie.
- If the drum requires decontamination, additional swabbing of the drum will be performed to remove the contamination. Remote-handled decontamination equipment is available in the cave to be used if additional swabbing is insufficient to meet disposal requirements.
- The cask transfer bogie moves to the cask lidding station where the cask lid is replaced onto the cask. The bogie then moves to a gamma monitor where radiation levels are verified before the import/export shield door is opened and the cask transfer bogie moves into the import/export area. Once the cask is in the import/export area and the import/export shield door is closed, operators enter to bolt the lid onto the cask. The monorail then moves the cask to the cask handling truck. The cask handling truck positions the cask under the truck bay crane. From the cask import/export area, ~~T~~the crane positions the cask on a vehicle for ~~removal~~transfer from the plant.

4.1.4.11 HLW Vitrification Plant Ventilation

The HLW vitrification plant will be divided into four numbered zones listed and defined below, with the higher number indicating greater radiological hazard potential and, therefore, a requirement for a greater degree of control or restriction. The zoning of the ventilation system will be based on the classifications assigned to building areas for potential radiological contamination. Zones classified as C5 are potentially the most contaminated and include the pour caves, buffer storage area, and process cells. Zones classified as C1 are uncontaminated areas.

Containment will be achieved by maintaining C5 areas at the greatest negative pressure, with airflows cascaded through engineered routes from C2 areas to C3 areas and on to the C5 areas. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and, hence, the amount of air requiring treatment. Adherence to this concept in the design and operation of the HLW vitrification plant will ensure that the plant air does not become a significant source of exposure to operators, and that the air emissions do not endanger human health or the environment.

An ~~effluent~~ exhaust air radiation monitoring system, consisting of sensors to monitor radiation in the exhaust air~~effluent~~ stream, or a representative sampling system is provided in the discharge header downstream of the exhaust fans. A monitoring system would consist of probe assemblies, vacuum pumps, a stack flow sensor, temperature sensor, and radiation sensors. A temperature transmitter is also provided in the discharge header downstream of the exhaust fans for continuous monitoring of exhaust air temperature.

C1 Ventilation System (C1V)

C1 areas will typically consist of offices, workshops, control rooms, and equipment rooms. They will be slightly pressurized if they are adjacent to areas with higher contamination potential~~,~~ to eliminate backflow from those areas.

C2 Ventilation System (C2V)

C2 areas will typically consist of operating areas, equipment rooms, stores, access corridors, and plant rooms adjacent to areas with higher contamination potential. The C2V is served by dedicated exhaust fans. Air supplied to the C2 areas ~~which~~ that is not cascaded to the C3 or C5 areas is discharged to the atmosphere by the exhaust fans. Both exhaust fans are provided with variable frequency drives. A manual isolation damper is provided upstream of each exhaust fan, and a pneumatically actuated isolation damper is provided downstream. Each damper is provided with local/remote position monitoring.

C3 Ventilation System (C3V)

C3 areas are normally unoccupied, but allow operator access, for instance during maintenance. C3 areas will typically consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Air will generally be drawn from C2 areas and, wherever possible, cascaded through the C3 areas into C5 areas, or alternatively exhausted from the C3 areas by the C3 exhaust system. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. When sufficient air cannot be cascaded into C3 areas, a dedicated C2 supply equipped with appropriate backflow prevention will be used.

C5 Ventilation System (C5V)

~~In general, air cascaded into the C5 areas will be from adjacent C3 areas. If there is a requirement for engineered duct entries through the C3 boundary, they will be protected by backflow HEPA filters, with penetrations through the boundary sealed~~Where there is in-bleed air from the C-3 to C-5 system, fan cascade trip interlocks protect the system from backflow.

The C5 areas in the HLW vitrification plant will be ~~comprised~~ composed of the following:

- Pour caves
- Transfer tunnel
- Buffer storage area
- ~~C3/C5 drain tank room~~
- Process cells

Air will be cascaded into the C5 areas and exhausted by the C5 exhaust system. Engineered duct entries (air in-bleeds) through the C5 confinement boundary will be protected by backflow ~~HEPA~~ filter isolation dampers, with penetrations through the boundary sealed.

4.1.5 Analytical Laboratory

The analytical laboratory will be ~~comprised of the high-activity and low-activity laboratories. Sample conveyance systems will automatically transport samples from the other process plants to the analytical laboratory. High activity samples will be managed in a hot cell area that will contain hot cells dedicated to specific analytical techniques or functions. The hot cell exhaust will be handled by the C5 ventilation system. Low activity samples will be managed in low activity laboratories. Each laboratory will have a specific function and analytical equipment. Fume hoods within these laboratories will be handled by the C3 ventilation system. The ventilation will be HEPA filtered and exhausted through the analytical laboratory stack.~~

~~Figure 4A-107 provides a the layout of the main floor of the analytical laboratory. In this layout, the following attributes are outlined~~designed to incorporate the features and capability necessary to ensure efficient WTP operations and meet ~~all~~ permitting, process control, authorization basis, and waste form qualification requirements. The design will be validated with information from tank utilization modeling of the process tankage~~,~~ and operational research modeling of the treatment process, as appropriate. Figures 4A-107 in DWP Attachment 51 provides a general layout of the first floor of the WTP analytical laboratory where analytical, maintenance, administrative, and waste management activities take place. The following attributes are outlined in the facility design figures described above:

- Workstations have been defined as required by the sampling and analysis plan for WTP process control and waste form qualification
- Capability to provide ~~the~~ limited process technology ~~is~~ will be provided ~~in both the hot cell area and the radiological laboratory rooms for specialized sample evaluations~~
- ~~Redundancy of major instrumentation has been accommodated~~

- Contamination controls have~~s~~ been incorporated for reliability of laboratory service to the WTP processes
- ~~Receipt and processing~~Management of DST system samples ~~are will be accommodated in both capability and capacity~~for receipt and analysis by an outsource laboratory

~~☐An administrative area has been provided to support a fully operational, stand-alone facility~~

Figures 4A-108 through 4A-117 found in DWP Attachment 51 provide additional detail for the analytical laboratory:

- General arrangement figures showing locations of analytical laboratory activities
- Process flow figures for process information
- Typical system figures depicting the analytical laboratory tank systems
- Figures depicting the ventilation system

The WTP analytical laboratory will contain high--activity and low--activity laboratories. High–activity samples will be managed in the analytical hotcell laboratory equipment system (AHL) ~~system~~. Low--activity samples will be managed and analyzed in the analytical radiological laboratory equipment ~~(rad labs)~~ system (ARL) also known as the rad labs. The ARL system also includes a sample management area designed to manage the inflow of manually transported samples. Most samples sent to offsite laboratories will be low-activity and environmental samples. Analytical methods and equipment selected to support laboratory analyses will be in accordance with applicable requirements.

The second floor of the analytical laboratory will be dedicated to the mechanical room, which contains the C1 and C2 air handling units. The ~~h~~RLD system vessels~~otcell drain collection vessel (RLD-VSL-00165), the laboratory area sink drain collection vessel (RLD-VSL-00164), and the floor drain collection vessel (RLD-VSL-00163)~~ will be located at approximately 19 ~~feet~~ below grade.

~~Regulated analytical laboratory tank system process and leak detection system instruments and parameters will be provided in Table III.10.E.H.~~

The facility will also be designed to coordinate the management of samples that will be outsourced and analyzed at offsite laboratories. Outsource laboratories will be used to analyze the majority of very low-activity samples such as water quality and air emission samples. Outsource laboratories may also be used to analyze DST system unit characterization samples.

Samples will be transported to the analytical laboratory in two ways. The majority of samples will be collected and transported from the processing facilities via ~~an automated system called~~ the autosampling system (ASX). Samples will be collected in a sample bottle or vial and transferred into a sample carrier. High-activity samples from the pretreatment and HLW vitrification plants will be pneumatically transferred to the hotcell sample receipt area through a dedicated transfer system for high-activity samples. Low-activity samples from the LAW vitrification plant and non-radioactive samples from the balance of facilities will be transferred directly to the ~~rad lab~~ sample receipt laboratory area through a dedicated low-activity transfer system. A small percentage of samples will be transported to the laboratory manually in appropriately shielded transportation casks or containers.

4.1.5.1 Analytical Radiological Laboratory Equipment System (Rad Labs)

The rad labs are being designed to support the preparation and analysis of low-to-moderately ~~radioactive~~mixed waste samples. The rad labs also support the analyses of high-activity ~~radioactive~~mixed waste plant samples collected, diluted, and processed in the hotcell facility. Samples will be manually transferred from the hotcell facility to the rad labs. The rad labs will be capable of receiving low-to-moderate activity samples transferred from the process facilities via the ASX system as well as manually transported low-to-moderate activity samples ~~aliquots~~ from the process facilities and other DOE facilities.

The rad labs include the facilities and equipment required to support activities such as:

- Sample receipt and (manual) transport
- Dissolution/dilution
- Distillation/titration
- Standard/reagent preparation
- X-ray fluorescence spectrometry and x-ray diffraction analysis

Fourier transformation infrared spectrometry (FT-IR)

- ~~Organic quantitation~~
- Total ~~organic and~~ inorganic analysesess
- Quantitation of metals and anions
- Ultraviolet and visible spectroscopy
- Preparation of glass samples for elemental analysis
- General physical properties analysis
- Radionuclide separation and counting
- Management of outsourced samples

4.1.5.2 Analytical Hotcell Laboratory Equipment System (AHL)

The analytical hotcell laboratory equipment system will be designed to provide sample preparation and analysis of high-activity samples collected at the WTP and other DOE facilities. The hot cells will be capable of accepting samples ~~taken automatically~~ from each of the production facilities ~~(~~using pneumatic transport~~)~~ ~~and will also be capable of accepting samples that are~~or transported manually. ~~Some of these~~The samples will be transported to the hot cells or to the rad labs either directly, after dilution, or after stripping off the radioactive content.

The analytical hotcell laboratories will include facilities and equipment necessary to perform activities such as:

- Sample receipt and transport to other hot cells and the rad labs
General physical properties analysis
- ~~Extraction for organic analyses~~
- Dilution, fusion, and acid digestion required to prepare samples for subsequent analysis
- Waste management activities

4.1.5.3 Autosampling System (ASX)

Samples will be collected ~~and transferred~~ into a sample bottle or vial and then transferred into a sample carrier. Sample carriers are then pneumatically transferred to either the laboratory hot cell or radiological laboratory depending on where the sample was collected. The ASX system consists of high-activity and low-activity sampling systems. The high-activity sampling system collects and pneumatically transfers samples from the PT and HLW vitrification plants to the receipt cell within the hot cell laboratory. Low-activity samples collected from low-activity waste streams are pneumatically transferred directly to the radiological laboratory.

4.1.5.4 ~~Radioactive Solid~~Solid Waste Management

Solid m~~Solid~~ixed and dangerous waste will be accumulated in the hot cells and periodically placed in waste drums. Waste from the individual hot cells will be transferred to a waste management cell where waste management, consolidation, and packaging activities are conducted. The waste cell contains tools and equipment to complete size reduction. These solid mixed and dangerous wastes as well as organic lab pack wastes will be transferred into waste drums prior to being transferred to the laboratory waste drum management area. Ventilation flow from the hot cell area, including the waste cell, will be routed to the C5 HEPA filtration system.

Solid mixed and dangerous waste and organic lab pack wastes from the rad labs and maintenance areas will be accumulated in the individual labs and shops until they are transferred to the laboratory waste management area for waste consolidation and volume reduction. Waste consolidation will be completed in the volume reduction and lab pack rooms in the waste drum management area.

Waste drums will be ~~managed in the management area prior to~~ transferred to a permitted TSD site or low level radioactive waste facility. Lab pack drums or waste drums containing liquid mixed or dangerous wastes will be managed on spill pallets. The management area will be coated with a special protective coating and the area will be ventilated to the C2 ventilation system. Floor drains from the waste management area will flow into the ~~l~~Laboratory ~~f~~Floor ~~d~~Drains ~~c~~Collection ~~v~~Vessel (RLD-VSL-00163).

4.1.5.5 Radioactive Dangerous Liquid Waste Disposal System (RLD)

The analytical laboratory RLD system is primarily ~~comprised~~composed of the following:

- ~~f~~Floor ~~d~~Drain ~~c~~Collection ~~v~~Vessel (RLD-VSL-00163)
- ~~, the l~~Laboratory ~~a~~Area ~~s~~Sink ~~c~~Collection ~~v~~Vessel (RLD-VSL-00164)
- ~~, the h~~Hotcell ~~d~~Drain ~~c~~Collection ~~v~~Vessel (RLD-VSL-00165)
- ~~, and the a~~Associated ancillary equipment~~ and secondary containment systems.~~

The ~~f~~Floor ~~d~~Drain ~~c~~Collection ~~v~~Vessel (RLD-VSL-00163) collects, contains, and transfers non-contaminated liquid effluent. Although the floor drain collection vessel is identified as part of the RLD system, it is not designed or permitted to manage ~~radiological~~mixed or dangerous wastes. If a spill or release were to occur that contaminated this ~~tank~~vessel, the ~~tank~~vessel would be discharged to the ~~l~~Laboratory ~~a~~Area ~~s~~Sink ~~c~~Collection ~~v~~Vessel (RLD-VSL-00164) or the ~~h~~Hotcell ~~d~~Drain ~~c~~Collection ~~v~~Vessel (RLD-VSL-00165) and ~~be~~ rinsed with waster prior to being returned to service. This vessel collects effluent from radiological laboratory floor drains, eyewash, and safety shower equipment. The vessel also collects effluent from the C2 area floor drains located in areas such as the laboratory area corridors, hot-cell bay area, and the filter room.

Regulated analytical laboratory tank system process and leak detection system instruments and parameters will be provided in DWP Table III.10.E.H.

4.1.5.6 Laboratory Maintenance

The analytical laboratory maintenance shop provides space for performing preventive and corrective maintenance on laboratory equipment. There will be two shops, located in different potential ~~radioactive~~ contamination areas. The C3 shop allows decontamination, maintenance, and storage of contaminated equipment such as hotcell manipulators. The C3 maintenance shop will be ventilated to the C3 ventilation system, and effluent from the C3 maintenance shop discharges to the ~~l~~Laboratory ~~a~~Area ~~s~~Sink ~~c~~Collection ~~v~~Vessel (RLD-VSL-00164). The C2 shop will provide space for the maintenance of equipment that is not expected to be radioactively contaminated such as electrical components, utilities systems components, and instruments, and will be ventilated to the C2 ventilation system. A list of proposed maintenance activities that will be performed in the analytical laboratory maintenance shops is provided below.

Analytical Laboratory Maintenance and Waste Management Activity Summary

Task Description	Lab C3 Shop	~~IN-SITU~~In Situ Activities
Filter c~~C~~hange -out [a]		X
Manipulator r~~R~~epair [b]	X	X
Valve ~~M~~maintenance	X	X
Pump ~~M~~maintenance	X	X
Exhaust f~~F~~an ~~M~~maintenance	X	X
Repair and f~~F~~abricated e~~E~~quipment	X	X
Instrument c~~C~~alibration	X	X

a Spent filters will be disposed of following filter change -out using approved maintenance, waste management, and radiological procedures.

b Manipulators requiring extensive repairs will be pulled and transferred to the C3 workshop for decontamination. Once the contamination levels are reduced to within acceptable limits for hands-on maintenance, the manipulator will be repaired using approved maintenance and radiological procedures.

4.1.5.7 Laboratory Ventilation Systems

The analytical laboratory ventilation systems include C1V, C2V, C3V, and C5V systems that aid in the containment and confinement of ~~radiological~~mixed and dangerous constituent hazards. Clean occupied areas without contamination potential are classified as C1 and will be isolated from normally clean occupied areas with the potential for contamination (C2) and from areas with restricted occupancy, normal radiological hazards and higher contamination potential (C3 and C5).

C3 areas are restricted occupied areas~~,~~ and allow operator access under administrative controls as required for scheduled maintenance and operations. C5 areas have the highest contamination potential and will normally be unoccupied. These areas have, by virtue of their location and the activities performed within them, an increased potential for the release of contamination. The analytical laboratory C5 ventilation system will be an integral part of the complete analytical laboratory HVAC system. The design objectives of the analytical laboratory HVAC system, and therefore the C5 area ventilation system, will be as follows:

- Aid in the confinement and containment of ~~radiological~~mixed and dangerous constituent contamination sources
- Remove airborne particulates from the discharge air to ensure that emissions are within prescribed limits
- Maintain space temperatures within the indoor design conditions
- Satisfy s~~S~~afety r~~R~~equirements and c~~C~~odes and s~~S~~tandards that are a part of the Safety Requirements Document

The C5 area ventilation system is being designed to maintain a negative pressure in the C5 areas with respect to the surrounding areas. Hotcell ventilation, the ~~h~~Hotcell ~~d~~Drain ~~c~~Collection ~~v~~Vessel (RLD-VSL-00165), and the C3 maintenance shop glovebox will be exhausted to the C5 ventilation system. Fume hoods within the rad labs, the waste reduction and lab pack room, and the C3 maintenance shop will be exhausted to the C3 ventilation system. The ventilation from ~~C1,~~ C2, and C3 areas will be filtered through a single stage of HEPA filters and exhausted through the analytical laboratory stacks. Air cascading into the C5 areas from the adjacent C2 and/or C3 areas~~,~~ will be exhausted through the analytical laboratory building stack by the C5 exhaust fans after passing through two stages of HEPA ~~f~~Filter banks.

~~Figure 4A-108 provides a layout of the second floor. The second floor of the analytical laboratory provides for analyses and segregation of the radioactive samples from the low and non-radioactive samples. Reliability is assured that contamination of the low-active samples will not be problematic. There are no entrances directly between the main floor and the second floor without egress through the change rooms. Samples are introduced through an outside door directly to the second floor. Prepared sample aliquots for radionuclide quantitation are transferred by dumbwaiter directly to the appropriate counting room.~~

~~Room is available to process essential materials and prepare reagents for laboratory performance monitoring using standards and laboratory reagents. The second floor also provides ample office space for the professional staff, including a conference room and training room space, data package assembly and oversight, and support staff for the laboratory information management system.~~

~~The hot cell area includes a row of hot cells that support WTP Process Technology as shown in Figure 4A-109. Two below-grade counting rooms are shown in Figure 4A-110 near the below-grade tank system. The counting rooms are located below grade to make use of the shielding from the earth surrounding the room to reduce the background in the rooms as much as possible. One counting room is dedicated to the effluent level, radionuclide quantitation, and the second is dedicated to high radionuclide concentration samples. Dumbwaiters deliver the prepared sample aliquots from the high activity laboratories to the high activity counting room, and the prepared mounts from effluent samples to the low activity counting room. Radionuclide detection levels necessary to manifest the retention basin water for disposal at treated the LERF/ETF can be met in this facility. Most instrumentation is duplicated in each counting room; however, certain specialized instrumentation is provided uniquely where applicable.~~

~~The wall separating the two counting rooms provides shielding from the gamma emissions from high-activity samples entered into the high activity room. Wastes generated in the analytical laboratory will be recycled through the pretreatment process or packaged and transferred to the central waste storage facility awaiting disposal.~~

~~The following figures found in Appendix 4A provide additional detail for the analytical laboratory:~~

~~□Simplified process flow figure for process information~~

- ~~Typical system figure depicting common features for the regulated tank system~~
- ~~Simplified general arrangement figures showing locations of equipment and tanks~~
- ~~Contamination/radiation area boundary figures showing contamination/radiation zones throughout the lab~~

~~Descriptions of the analytical laboratory process and mechanical handling systems are provided in the following sections.~~

~~Autosampling Systems~~

~~The sampling will be performed by a computer-controlled autosampler system. A clean sample vial is pneumatically transferred to the autosampler unit, where the vial is mounted on a sample needle through the vial septum. The other end of the sample needle penetrates a sample loop that is circulated by a reverse-flow diverter. A venturi effect on the sample needle creates a slight negative pressure in the sample vial, as the diverter circulates the waste through the sample loop. When the flow in the sample loop slows to a stop, the venturi effect ceases and waste is drawn into the sample vial. The vial is withdrawn from the needle after the appropriate sample volume is collected, placed in a carrier and pneumatically transferred to a shielded sampling cabinet in the laboratory for sample preparation and analysis.~~

~~High Activity Laboratory~~

~~The high activity laboratory will consist of a main sample receipt area and several hot cells. Descriptions of these areas are summarized below:~~

~~High Activity Laboratory Receipt Facility~~

~~The high activity laboratory receipt facility will remove the sample bottle from the sample carrier and moves it into the high activity laboratory hot cells. The laboratory receipt facility will be equipped with a gamma monitor to detect residual radiation.~~

~~Hot Cells~~

~~The high activity samples will be handled in hot cells. The hot cells will include equipment and facilities to perform activities such as the following:~~

- ~~Sample receipt~~
- ~~Total Organic analysis~~
- ~~Glass sample preparation~~
- ~~Toxicity Characteristic Leaching Procedure (TCLP) analysis~~
- ~~Gamma analysis~~
- ~~General physical properties analysis~~

~~Low Activity Laboratory~~

~~The low activity samples will be handled in the low activity laboratories. The main activities that will be performed in these laboratories are listed below:~~

- ~~Sample dispensing~~
- ~~X ray spectrometry (XRF) and X ray diffraction (XRD) analysis~~
- ~~Total organic analysis~~
- ~~General chemistry analysis with differential scanning calorimeter, cold vapor atomic absorption, cyanide analysis, ion chromatograph~~
- ~~Atomic Emission Spectroscopy (AES)~~
- ~~Gamma and alpha analysis~~

~~Sampling Methods~~

~~Methods and equipment selected for use will meet the applicable requirements of the specific SW-846 or other appropriate sampling or analysis procedures. Modifications of a procedure, other than sample size, will be requested in accordance with applicable requirements.~~

~~Cascade Ventilation System for Analytical Laboratory Hot Cells~~

~~A primary factor in the design of the ventilation system for the WTP is the need to isolate the sources of radiation, and radiological and dangerous waste contamination, to protect human health and the environment during normal and abnormal operating conditions. Barriers or barrier systems, including ventilation systems, will contain and minimize the release of radionuclides and contaminants. The ventilation systems are designed to conform to stringent nuclear facility ventilation standards, and fugitive emissions from the pretreatment and vitrification facilities will be minimized.~~

~~The pretreatment plant, LAW vitrification plant, HLW vitrification plant, and analytical laboratory will be divided into five numbered zones, with the higher number indicating greater contamination potential and, therefore, a requirement for a greater degree of control or restriction. A separate zoning system for the ventilation systems will be based on the system for classifying building areas for potential contamination. Zones classified as C5 will have the potential for the greatest contamination and will include the pretreatment cells, melter cells, and glass pouring and cooling cells. C5 zones will be operated remotely. Zones classified as C1 will be those areas that have no risk of contamination, such as equipment rooms and offices.~~

~~Confinement will be achieved by maintaining the greatest negative pressure for areas with greatest contamination (e.g., C5 areas), with airflows cascade from least to most contaminated areas (e.g., C1 or C2 to C5 areas). The principle of a cascade system, in which air passes through more than one area, effectively reduces the number of separate ventilation streams and hence the amount of air requiring treatment. Adherence to this principle in the design and operation of the WTP will ensure that the plant will not become a significant source of radiological or dangerous waste exposure to operators, or emissions to the environment.~~

4.1.6 Balance of Facilities

The ~~BOF~~ balance of facilities will ~~include, by definition,~~provide support systems and utilities required for the waste treatment processes within the pretreatment plant, LAW vitrification plant, HLW vitrification plant, and analytical laboratory. ~~Specific operational facilities will be~~

~~established to provide the BOF support systems and utilities~~. These will include, but will not be limited to, heating and cooling, process steam, process ventilation, chilled water, primary and secondary power supplies, and compressed air~~. Local control panels will be provided in each building, with the main control room located at the pretreatment plant~~.

~~Unlike the waste treatment process areas, the BOF support systems and utilities will not manage dangerous waste, therefore this section is provided for information purposes only.~~

4.1.6.1 ~~Instrument Service Air (ISA) and~~ Plant Service Air Systems (PSA) ~~Systems~~

The ~~process~~ plant service air system will provide a continuous supply of compressed air for the process tanks and vessels in the pretreatment plant, analytical laboratory, LAW vitrification plant, ~~and~~ HLW vitrification plant~~s~~, and other miscellaneous uses~~. The instrument air system will receive air from the process air system, and further dry the air through dessicant dryers. Process air and instrument air that have entered the process plants will not return to the BOF~~.

Critical users (those who would be compromised or damaged by loss of process air) will include the following systems, components, or controls:

- Instrument air system
- The ultrafiltration system
- Melter support systems

The compressors will be located in the chiller/compressor building.

4.1.6.2 Plant Cooling Water System (PCW) ~~System~~

The cooling water system will supply cool water to heat exchangers supporting process equipment coolers. Cooling water will remove heat from plant equipment coolers in the process buildings and return the heated water to a multi-cell mechanical draft-cooling tower where the heat will be released. The cooling water system is designed to remain uncontaminated by ~~chemical and radiological~~mixed waste constituents. The cooling water will be chemically treated ~~and filtered~~ to promote system operability and extend service life to 40 years.

4.1.6.3 Low-Pressure Steam System (LPS) ~~System~~

~~The low-pressure steam system operates at approximately 85 psig at 330 °F.~~ This system will provide a continuous supply of low--pressure steam for various users in the pretreatment plant, LAW vitrification plant, and HLW vitrification plant~~s~~. The process plants' main use of steam will be for tank heating, ~~and~~ for the evaporation process, and for HVAC heating coils.

The low-pressure steam system will be supplied from the high-pressure steam system through pressure-reducing stations. The steam condensate and feed system will collect condensate from the low-pressure steam users, monitor for ~~radioactivity~~mixed waste contamination, and return it to the steam plant for re-use..

4.1.6.4 High-Pressure Steam System (HPS) ~~System~~

The system will provide a continuous supply of high-pressure ~~(approximately 135 psig at 360 °F)~~ steam for the ejectors in the pretreatment plant, LAW vitrification plant, and HLW vitrification plants~~. Once this steam enters the process buildings there will be no return streams to the BOF~~.

The steam plant will house the boilers that produce the steam.

4.1.6.5 Demineralized Water System (DIW) ~~System~~

This system will distribute demineralized water to various plant locations, after drawing it off the process water system (described below)~~. Once the demineralized water enters the process buildings it will not return to the BOF~~.

The system can deliver demineralized water for the following processes:

- Fresh ion exchange resin addition
- Wash rings
- Decontamination
- Melters
- Analytical laboratory

4.1.6.6 Process Service Water System (PSW) ~~System~~

This system will supply ~~raw~~ filtered water to end users. This water will serve processes such as offgas treatment, plant wash systems, and make-up to chilled water systems ~~and process reagent systems. Once the process water enters the process buildings it will not return to the BOF~~.

4.1.6.7 Chilled Water System (CWS) ~~System~~

This closed–loop system will supply chilled water to various HVAC unit cooling coils and plant equipment coolers for the WTP~~. The system is a closed loop and will provide approximately 65 psi at the junction with process buildings~~. Chilled water will be used in various systems throughout the WTP. The chilled water system is designed to remain uncontaminated by ~~chemical and radiological~~mixed waste constituents. The chilled water will be chemically treated to promote system operability and extend the service life to 40 years.

4.1.6.8 Glass Former Reagent System (GFR)

The glass former reagent system (the GFR system does not manage dangerous waste and is provided for information only) provides glass former reagents and sucrose to the LAW and HLW vitrification facilities.

4.2 WASTE MANAGEMENT UNITS

The following sections provide information on the waste management units at the WTP:

- Containers, including management and storage areas - s~~S~~ection 4.2.1
- Tanks systems for storage and treatment - ~~S~~section 4.2.2
- Miscellaneous units - ~~S~~section 4.2.3
- Containment buildings - ~~S~~section 4.2.4

4.2.1 Containers [D-1]

This section of the ~~application~~ permit identifies the containers and container management practices that will be followed at the WTP. The term "container" is used as defined in Washington Administrative Code (WAC) 173-303-040. Note that in the ~~DWPA~~permit, terms other than containers may be used, such as canisters, boxes, bins, flasks, casks, and overpacks.

~~The container storage areas located in the LAW vitrification plant are~~is:

~~□ILAW buffer container~~ buffer ~~storage area (immobilized glass)~~ ~~(L-B025C/D)~~
~~ILAW container storage area (immobilized glass)~~
~~□LAW container storage area (secondary waste)~~

The container storage areas located in the HLW vitrification plant are:

- IHLW ~~container~~ canister storage ~~area~~ cave (immobilized glass) (H-0132)
- HLW ~~container storage area 1E~~east corridor El. 0 ft[2] (secondary waste) (HC-0108/09/10)
- HLW ~~container storage~~loading area ~~2~~ (secondary waste) (H-0130)

~~□HLW container storage area 3 (secondary waste)~~

The container storage area (secondary waste) located within the analytical laboratory is:

- Laboratory waste management area (A-0139 and A-0139A)

The container storage areas (secondary waste) located within the ~~BOF~~ balance of facilities are:

~~□Central waste storage facility~~
- Non-radioactive dangerous waste storage area
- ~~LAW out-of-service~~Failed melter storage facility

~~□HLW out-of-service melter storage facility~~

Container storage area dimensions at the WTP are summarized in Table 4-2.

The following sections address waste management containers:

- Description of Containers - ~~S~~section 4.2.1.1
- Container Management Practices - ~~S~~section 4.2.1.2
- Container Labeling - ~~S~~section 4.2.1.3
- Containment Requirements for Storing Waste - ~~S~~section 4.2.1.4
- Prevention of Ignitable, Reactive, and Incompatible Wastes in Containers - ~~S~~section 4.2.1.5

4.2.1.1 Description of Containers [D-1a]

Four types of waste will be managed in containers:

- IHLW (immobilized glass)
- ILAW (immobilized glass)
- Miscellaneous mixed waste (secondary waste)
- Miscellaneous non-radioactive dangerous waste (secondary waste)

The waste form dictates the type of containers used for waste management. The following paragraphs describe these four types of ~~containers~~ containerized waste ~~which~~ that are managed by the WTP.

Immobilized Glass Waste

The immobilized glass waste is a mixed waste that will be managed in ILAW containers and IHLW canisters specially designed to remain stable during receipt of glass waste, and which are capable of remote handling.~~ Schematics of the example IHLW containers canisters and ILAW containers are presented in Figures 4A-118 and 4A-119Attachment 51.~~ A petition to delist the IHLW is being developed and is planned to be submitted to the regulatory agencies for their approval.

The ILAW ~~immobilized glass waste~~ containers will be approximately 90 ~~inches~~ in. high and 48 ~~inches~~ in. in diameter, with a wall thickness of approximately 0.187 ~~inches~~ in. and a nominal capacity of 90 ~~cubic feet~~ft^3. ILAW containers will be constructed of austenitic (304) stainless steel.

The IHLW canisters will be approximately 177 ~~inches~~ in. high and 24 in.~~ches~~ in diameter, with a wall thickness of approximately 0.1345 ~~inches~~ in. and a nominal capacity of 43 ft^3~~cubic feet~~. The IHLW canisters will be constructed of austenitic (304L) stainless steel.

Based on results from the programs at the Oak Ridge National Laboratory and Savannah River Technology Center, the 304L stainless steel is physically and chemically compatible with the IHLW glass waste.

Miscellaneous Mixed Waste

Generally, miscellaneous mixed wastes are secondary wastes that may include, but are not limited to, the following items:

- Spent or failed equipment
- Spent, dewatered ion exchange resins in the pretreatment plant
- Offgas HEPA filters
- Melter consumables
- Analytical laboratory waste
- ~~Out-of-service~~Spent melters

Spent equipment and offgas filters will typically be managed in commercially-available containers such as steel drums or steel boxes, of varying size. The containers for miscellaneous mixed waste will comply transportation requirements, with receiving TSD waste acceptance criteria, and will be compatible with the miscellaneous mixed waste. These containers may or may not include a liner. Final container selection, container and waste compatibility, and the need for liners, will be based on the physical, chemical, and radiological properties of the waste being managed.

Spent~~,~~ ~~dewatered~~ ion exchange resins will be dewatered and managed in containers ~~that will be approximately 100 in. high by 88 in. on a side~~. This waste will be generated and managed in the pretreatment plant, until it is ~~moved to the central waste storage area or shipped to a Hanford Site~~ transferred to a suitable TSD unit for further management. ~~The containers for this miscellaneous mixed waste will comply with receiving TSD waste acceptance criteria.~~

Melter consumables are routinely generated wastes and include spent feed tubes, pressure transducers, bubblers, and discharge risers. LAW melter consumables will be placed into ~~steel~~ approved disposal containers of varying size. HLW melter consumables will be ~~placed into commercially-available steel containers~~remotely size reduced and placed into steel baskets with lids. The baskets will be placed into drums and the drums placed into shielded casks for export from the facility.

The LAW ~~locally~~ Locally ~~s~~Shielded ~~melter~~ Melter (LSM) ~~is a *Resource Conservation and Recovery Act* (RCRA)(RCRA 1976) miscellaneous unit within a welded container or overpack. The radiological shielding containing the melter will serve as the melter's final disposal container. When the locally shielded melter has reached the end of its operational life, it will be disconnected from systems. The overpack will then be prepared for disposal~~will be classified as hazardous debris for land disposal restrictions purposes.

After a HLW ~~melter~~ Melter is deemed to be waste, it will be removed from service and placed in a welded carbon steel container (overpack) ~~approximately 21 × 18 × 16 ft high~~.

Each miscellaneous mixed waste container will have associated documentation that describes the contents, such as waste type, physical and chemical characterization, and radiological characterization. This information will be retained within the plant information network.

Most miscellaneous secondary mixed wastes will be spent equipment and consumables such as pumps, air lances, HEPA filters, etc., and are not expected to contain liquids. If wastes are generated that contain liquids, these wastes may be treated to remove or absorb liquids, to comply with the receiving TSD waste acceptance criteria. In addition~~ to solid wastes~~, the analytical laboratory will generate containerized liquid waste (lab packs).

Miscellaneous Non-~~R~~radioactive Dangerous Waste
Each non-radioactive dangerous waste container will have associated documentation that describes the contents, such as waste type and physical and chemical characterization. Typically, commercially available containers~~, such as steel drums,~~ will be used. The types of containers used for packaging non-radioactive dangerous waste will comply with the receiving TSD waste acceptance criteria and transportation requirements. However, final container selection, container and waste compatibility, and the need for liners will be based on the physical and chemical properties of the waste being managed.

4.2.1.2 Container Management Practices [D-1b]

The following paragraphs describe how each of the containers used at the WTP are managed.

4.2.1.2.1 Immobilized Glass Waste Containers

Immobilized glass waste ILAW containers and IHLW canisters will be moved remotely due to the high radiation content of the waste. A brief discussion of how the containers move through the WTP is presented below. ~~The schematics of the locations for container storage areas located within the three plantspretreatment plant, HLW vitrification plant, LAW vitrification plant, and analytical laboratory are found in Appendix 4AAttachment 51. Stand-alone container storage area location schematics are found in Appendix 2AContainer storage areas located within the balance of facilities are identified in Appendix 2A.~~

ILAW Containers
An empty container will be transported to a LAW glass pour cave and placed on a turntable designed to hold three containers. There are two ILAW pour caves at each melter, each with the capacity to manage three containers at a time. The container will be sealed to the ~~melter~~ Melter discharge with a pour head connection. The glass waste will fill the container during the course of approximately ~~15 to 20~~10 hours. ~~The filled container will cool for 10 to 30 hours to reach glass transition temperature (approximately 400 °C to 500 °C), which characterizes the transformation from an equilibrated melt to a "frozen" glass structure. At this stage, the waste glass does not contain liquid and is in a viscous state that ultimately stabilizes to a solid.~~

The filled ILAW container will be lowered back onto the turntable. Once the container has cooled, it will be rotated to the ~~import/export~~transfer position. The container will then be lifted by a remotely operated crane onto a bogie and transported to the finishing line. In the event the finishing line becomes backed up, the container may be transported to the ILAW ~~buffer~~ container buffer storage ~~area~~containment building. The containers will not be stacked. Storage area dimensions ~~and maximum waste storage volumes are~~ summarized in Table 4-~~1~~2.

The container will be transported to the ILAW container finishing ~~containment building unit~~line (see s~~S~~ection 4.2.4), where the level of waste glass will be measured and additional inert filler will be added, if needed~~, to fill the container~~. A sample of the glass may also be collected in this location prior to inert filling. Glass within the neck of the container will be removed by abrasion and the lid will be attached to the container. The debris generated from residual glass removal will be collected with a vacuum system and disposed of as a secondary waste.

After the lid ~~welding~~ is ~~complete~~mechanically sealed, the container will be moved to ~~one of~~ the ~~two ILAW~~ decontamination cells ~~in the containment building unit,~~ where contamination will be removed. Using a turntable, the container will revolve while a power manipulator tracks the entire surface with decontamination equipment. The dry decontamination process will use carbon dioxide pellets. The container will then be transported to ~~one of~~ the ~~two ILAW~~ swabbing cells, where its surface will be swabbed ~~with a soft absorbent material~~. The radiation levels of the swab will be remotely monitored, and the results will determine whether the ILAW container will ~~go to the ILAW container storage area~~be ready for transportation to the disposal site, or go through decontamination again.

~~A container may also be transported to the ILAW container fixative area, where a fixative can be sprayed onto the its surface to immobilize detected radiological contamination. The container will then be transferred to the ILAW fixative curing cell area, where the fixative will be allowed to set. Container rework may also occur in this area. The container will then be moved to the ILAW container storage area. The containers will not be stacked. Storage area dimensions and maximum waste storage volumes are summarized in Table 4-2resurveyed prior to placement on the transporter for movement to the disposal site.~~

~~When the container is ready to be shipped out of the ILAW container storage area it will be transported to the export area, where it will be placed into a cask.~~

IHLW Canisters

The empty canister will be remotely transported to ~~one of~~ the ~~two~~ IHLW pour stations. The canister will be sealed to the melter pour spout with a pour head~~, and glass waste will fill the canister during the course of approximately two days~~. After filling, ~~a temporary lid will be placed on~~ the canister~~, which~~ will be allowed to cool to glass transition temperature (approximately 400 °C to 500 °C), which characterizes the transformation from an equilibrated melt to a "frozen" glass structure, prior to transportation to the IHLW canister weld containment building unit (see s~~S~~ection 4.2.4).

The IHLW canister will be transferred to the IHLW canister ~~weld~~ handling cave containment building unit by means of ~~an overhead crane~~a bogie. Here it will be stored on an open rack for up to three days, until it cools to normal operating temperature. Normal operating temperature is the temperature at which the canister can be lidded. This temperature range is 70 °F to 350 °F. In addition to providing a cooling area, the IHLW ~~weld~~ canister handling cave containment building unit can be used as a buffer to hold canisters awaiting lid welding or decontamination.

After it has cooled, the volume of glass in the canister will be determined. The canister will then be inspected for glass spatter on its exterior. If glass is found, it will be removed using a needle gun, and the debris generated will be collected with a vacuum system and disposed of as a secondary waste~~. The temporary lid will be removed and residue on the lid or within the neck of the canister will be removed by abrasion~~. The lid will be attached by welding, to seal the canister completely and permanently.

The sealed canister will be transported to the ~~IHLW~~ canister ~~decontamination containment building unit~~decon cave (HB035). The canisters are first rinsed with de-ionized water and then decontaminated using a cerium nitrate and nitric acid bath. It will then be rinsed with nitric acid, followed by a de-ionized water rinse, and then wiped or swabbed with a soft absorbent material ~~in~~at the canister swabbing and monitoring ~~cave~~area near the canister decontamination vessels. The radiation levels of the swab will be monitored.

The canister will then be moved to the IHLW canister ~~storage~~~~export~~storage ~~area~~ cave (H-0132) where it will be stored until transported off-site inside a shielded shipping cask. The canisters will not be stacked. Storage area dimensions and maximum waste storage volumes are summarized in Table 4-2.

Other IHLW ~~and ILAW Container~~ Canister Storage Requirements

As stated ~~under~~ in WAC 173-303-630(5)(c), a 30-in.~~ch.~~ separation is required between aisles of containers holding dangerous waste. In addition, WAC 173-303-340(3) requires a 30 in.~~ch.~~ separation to allow unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment in an emergency.

Evaluation of the 30-in.~~ch~~ aisle spacing requirement by the DOE, WTP, the EPA, and Ecology for ~~ILAW and~~ IHLW ~~containers~~ canisters concluded that aisle spacing in the range of 4 to 16 ~~inches~~ in. was adequate based on the following factors:

- Personnel access into the immobilized glass container storage areas will be restricted. High radiation dose rates from immobilized glass waste containers will preclude personnel entry into the process and storage areas, and inspection of the ILAW and IHLW containers will be performed remotely. (See Chapter 6 for the inspection approach.)~~.~~
- Water-based fire suppression systems will not be used in the container storage areas. Because of its inert nature, the glass waste will present a low fire hazard, and a minimal amount of combustible material will be present. The only potentially combustible material that may be present in the immobilized glass waste container storage areas is insulation on crane motors and associated cables. To ensure no water is introduced into the container storage areas, a dry chemical fire suppressant system may be installed.
- Spill control equipment will not be necessary within the ~~container~~ IHLW canister storage areas. Spills or leaks from the stored containers will not occur because the glass waste will be in a solid form and will not contain free liquid. The glass transition temperature characterizes the transformation from an equilibrated melt to a "frozen" glass structure~~. Preliminary estimates show that ILAW glass waste will cool to the glass transition~~

~~temperature in 10 to 30 hours, while the cooling time will be less for the smaller IHLW containers.~~

~~The ILAW containers will be stored on the floor of the storage area.~~ The IHLW ~~containers~~ canisters will be stored in a storage rack to allow airflow. No stacking of the containers will occur in the ILAW or the IHLW container storage areas. Closed circuit television cameras will enable general viewing of both areas.

Miscellaneous Mixed Waste Containers

Miscellaneous mixed waste (secondary waste) will be managed in:

~~□LAW container storage area~~

- HLW ~~container storage area 1e~~East corridor (HC-0108/09/10)
- HLW ~~container storage~~loading area ~~2~~(H-0130)

~~□HLW container storage area 3~~

- Failed melter storage facility (balance of facilities)
- Laboratory waste management area (A-0139)

~~□Central waste storage facility~~

Containers will be kept closed when managed in the container storage areas. Containers stored in these areas will be placed on pallets, or otherwise elevated to prevent contact with liquid, if present. Table 4-2 summarizes the dimensions and maximum capacity of miscellaneous mixed waste storage areas. Containers will be managed in ~~the HLW vitrification, and LAW vitrification plants~~designated areas throughout the WTP, and then transferred to ~~the central waste storage~~ a suitable TSD facility.

~~The LAW container storage area will be located in the western portion, on the main floor or ground level of the LAW vitrification plant. The aisle space will be 30 inches, and the waste containers will not be stacked. This units' storage capacity is listed in Table 4-2.~~

The HLW ~~econtainer storage area 1~~East corridor (HC-0108/09/10) will be located in the eastern portion of the main floor (0 ~~foot~~ ft elevation) of the HLW vitrification plant. This unit will be used as a storage location prior to export of secondary waste containers out of the plant. Aisle space will be 30 in~~ches~~., and waste containers may or may not be stacked. This units' storage capacity is listed in Table 4-2.

The HLW ~~container storage~~loading area ~~2~~(H-0130) will be located in the eastern portion on the ~~11~~ 0 ~~foot~~ ft elevation of the HLW vitrification plant. The unit will be used for storage of the miscellaneous waste containers prior to ~~storage in the central waste storage~~shipment to a suitable TSD facility. The aisle space will be 30 ~~inches~~ in. and waste containers may or may not be stacked. This units' storage capacity is listed in Table 4-2.

The ~~HLW container storage area 3 will be located in the eastern portion on the 11 foot elevation of the HLW vitrification plant. The unit will be used for storage of the miscellaneous waste containers prior to storage in the central waste storage facility. The aisle space will be 30 inches and waste containers may or may not be stacked. This units' storage capacity is listed in Table 4-2~~failed melter storage facility will be a stand-alone building. It will be used primarily to manage HLW melters that have completed their useful service life. The failed melters storage facility may also receive containerized miscellaneous mixed waste, if needed.

The laboratory waste management area (A-0139) will be located in the southern portion on the 0 ~~foot~~ ft elevation of the analytical laboratory. The unit will be used for storage of miscellaneous waste containers prior to disposition to a receiving TSD facility. The aisle space will be 30 ~~inches~~in. and waste containers may or may not be stacked. This unit's storage capacity is listed in Table 4-2.

~~The central waste storage facility is a waste container storage area where containers of mixed waste are received from various WTP facilities in a ready-to-transport state for consolidation into truck-load shipments. The central waste storage facility is a prefabricated metal structure on a concrete foundation pad. The foundation will be constructed to support fork-lift traffic and the waste containers will be palletized. Containers may be stacked on pallets no more than two high. Aisle spacing will be at least 30 inches. The perimeter of the central waste storage facility concrete base will be curbed to ensure that rain water does not infiltrate the waste storage area. The concrete base will be covered with a protective coating, and sloped to a grated sump. The containerized waste, which may be radioactive or mixed waste, will be fully characterized and required sampling will be completed prior to transfer to central waste storage facility. Waste containers will qualify for contact handling and meet the current applicable waste acceptance criteria established by the receiving storage, treatment, or disposal facility.~~

~~The central waste storage facility will not have capabilities for waste repackaging, waste compaction, waste reduction, grouting, or other form of waste treatment or internal waste inspection. Waste containers will not be opened at the central waste storage facility. The central waste storage facility may receive waste container containing free liquids, ignitable or reactive waste, or lab packs that contain liquids, ignitable, or reactive waste. Waste that is returned to WTP will be routed to the generating facility where the waste originated for resolution of discrepancies or issues. This units' storage capacity is listed in Table 4-2. As the facility will not be treating, repackaging, or opening waste containers, emission control equipment is not anticipated.~~

~~Miscellaneous Non-Radioactive Dangerous Waste Containers~~

~~Miscellaneous dangerous waste containers will be managed in a stand-alone building (the non-radioactive dangerous waste container storage area). This container storage area will have a protectively coated concrete floor and a 10 ft high metal roof. Containers will be kept closed unless waste is being placed inside them. They will routinely be moved by forklift or drum cart, and will be managed in a manner that prevents rupturing or leaking. The non-radioactive dangerous waste container storage areas' storage capacity is listed in Table 4-2. The containers may be stacked two high. The aisle spacing will be 30 inches between rows of containers.~~

~~Containers stored in this area will be placed on pallets, or otherwise elevated to prevent contact with liquid, if present.~~

Miscellaneous Non-~~R~~radioactive Dangerous Waste Containers

Miscellaneous dangerous waste containers will typically be managed in the non-radioactive dangerous waste container storage area, or in non--permitted waste management units (satellite accumulation areas and less--than--90--day storage areas) located throughout the WTP. The non-radioactive dangerous waste container storage area will consist of a concrete pad approximately 25 ~~feet~~ft by 30 ~~feet~~ft. The area may include a metal roof or portable storage buildings such as cargo containers or storage lockers. Containers will be kept closed unless waste is being added, removed, or sampled. They will routinely be moved by forklift or drum cart, and will be managed in a manner that prevents ruptures and leaks. The storage capacity for the non-radioactive dangerous waste container storage area is listed in Table 4-2. The containers in that area may be stacked two high and aisle spacing will be at least 30 ~~inches~~in. between rows of containers. Containers stored in this area will be placed on pallets, or otherwise elevated to prevent contact with liquid, if present.

4.2.1.2.2 Waste Tracking

~~The plant information network will be a manufacturing execution system designed to collect and maintain information enabling the optimization of the WTP activities from order launch to finished product. The plant information network consists of software applications designed to meet specific requirements and functions.~~

~~The plant information network will consist of the following systems:~~

- ~~Maintenance management system~~
- ~~Plant data warehouse and reporting system~~
- ~~Laboratory information management system~~
- ~~Waste tracking and inventory system~~

~~The plant information network will interface with the integrated control network. The integrated control network will consist of the process control system, mechanical handling control system, and the autosampling control system.~~

~~Inventory and Batch Tracking~~
~~The waste tracking and inventory system serves as the main repository for the relevant information pertinent to a given waste batch. Data is collected for each sequence or step throughout the processing history of a given batch of waste, from receipt of raw feed to disposition of the finished products, including secondary waste. At the end of a batch cycle, the data applicable to that particular batch will be catalogued to facilitate historical recording and reporting.~~

~~The waste tracking and inventory system will also record the inventory of immobilized waste containers, including the data generated for each immobilized waste container, and final quality assurance checks. Each immobilized waste container will bear a unique identification number to facilitate tracking.~~

~~Sample Tracking~~

~~Sampling activities will be started, monitored, and controlled by the integrated control network, with key sequence durations and operations logged into the waste tracking and inventory system directly from the integrated control network. Sampling operations will be requested by the integrated control network, plant operators, or laboratory personnel. These requests will be time and date stamped, as will the actual sampling operation and the associated sample handling and laboratory activities. Sample requests and operations will be channeled through the integrated control network, which will operate in a supervisory capacity and will communicate the necessary information to the waste tracking and inventory system.~~

~~The laboratory information management system will be an integral feature of the plant information network. Workstations will be located within the laboratory and the plant control rooms. The laboratory information management system will record the required quality control checks to assure correct sample preparation and selection of analyses, and controlled checking and approval of results.~~

~~Sample containers received in the laboratory preparation area will be identified by their identification label. The identification label provides details of the sample source and, therefore, specifies the required preparation and analysis techniques. The identification will be registered at the locations where manual intervention is required, such as manual samplers. The results of calibration checks on equipment and analyzers will be recorded.~~

~~Analytical results will be compiled by the laboratory information management system and held, pending checking and approval by laboratory staff, before formally recorded within the waste tracking information system. Results that affect the progression of the main plant process will be communicated to appropriate plant personnel where required. WTP samples that come under the exclusion provided in WAC 173-303-071(3)(l) may not be tracked.~~

~~Secondary Waste Stream Tracking~~

~~Secondary waste streams will be tracked within the waste tracking and inventory system in a manner similar to that primary waste streams. Secondary waste streams will be managed by using assigned, unique identification numbers. Corresponding histories and data collection triggers will gather process and status information during the processing of secondary waste in order to satisfy tracking of waste disposal records. Shipments of overpacks will be labeled and tracked as part of the inventory control function of the waste tracking and inventory system.~~

~~Maintenance, decommissioning, or disposal activities may generate consumables, including such items as equipment, hardware, personal protective equipment, and materials used in the normal operation of the Plant. Consumables that are designed as dangerous will be tracked by the maintenance management system, with appropriate fields denoting the hazardous classification~~

~~of the disposed parts and materials, and cross-linked to disposal records. Waste being accumulated in satellite accumulation areas under the provisions of WAC 173-303-200 may not be tracked until it has been accepted into a permitted portion of the WTP.~~
The plant information network interfaces with the integrated control network and is designed to collect and maintain plant information. The plant information network is currently planned to the following systems:

- Plant data warehouse and reporting system
- Laboratory information management system
- Waste tracking and inventory system

Inventory and Batch Tracking
The waste tracking and inventory system will interface with the information system data historian to provide reporting information such as tank volumes, waste characteristics, and facility inventories of process waste. The waste tracking system will also be used to query operations parameters at any time information is needed, as specified by operations, to manage the process system. IHLW canisters and ILAW containers will be tracked within the facility using an operations developed system: for example, manually recording on a board, manually inputting into the information network, or if available automated through the integrated control network.

Secondary Waste Stream Tracking
Containerized secondary waste streams and equipment will be tracked and managed through commercially available database management software. Containers will be mapped in each ~~facility~~plant and updated during the inspection process using a commercially available drawing software application.

Laboratory Information Management System
The laboratory information management system (LIMS) will be an integral feature of the plant information network. The LIMS will serve as an essential tool for providing data management of regulatory and processing samples. The chosen LIMS ~~system~~ will be a commercial -off-the-shelf software package designed for performing laboratory information management tasks as described in ASTM E1578-93, *Standard Guide for Laboratory Information Management Systems (LIMS)*.

The LIMS will track the flow of samples through the laboratory. Samples received in the laboratory will be identified with a unique identification label. The identification label provides details of the sample process stream. Baseline analyses are defined by the requesting ~~facility~~plant. Additional analyses, as required, will be input into LIMS by laboratory analysts. Data will be input into LIMS manually or by data transfer using LIMS/instrument interface. Analyses will be performed using approved and validated analytical procedures.

Analytical results will be compiled by the LIMS and held pending checking and approval by appropriate staff. Approved results will be reported to the requesting ~~facility~~plant.

4.2.1.3 Container Labeling [D-1c]

Immobilized Waste Glass Containers

Due to the radioactivity and ~~remote~~ handling requirements of the immobilized waste containers, conventional labeling of the immobilized waste containers will not be feasible and an alternative to the standard labeling requirements will be used. This alternative labeling approach will use a unique alphanumeric identifier that will be welded onto each immobilized glass waste container. The welded "identifier" will ensure that the number is always legible, will not be removed or damaged during container ~~decontamination~~handling, will not be damaged by heat or radiation, emits no gas upon heating when waste glass enters the container, and will not degrade over time.

The identifier will be welded onto the shoulder and side wall of each immobilized glass container at two locations 180 degrees apart. Characters will be approximately 2 in. high by 1.5 in. wide~~ (sSee Figures 4A-118 and 4A-119Attachment 51 for examples of these identifiers)~~. The identifier will be formed by welding on stainless steel filler material at the time of container ~~construction~~fabrication. This identifier will be used to track the container from receipt at the WTP, throughout its subsequent path at the WTP, until it leaves the plant to be disposed or stored.

Each identifier will be composed of eight coded alphanumeric characters. For example, HL123456 would be an immobilized waste glass container storing ~~Hanford~~ ILAW with the unique number 123456, and HH123456 would denote an IHLW ~~container~~canister. This unique number will be maintained within the plant information network~~,~~ and will list data pertaining to the waste container including waste numbers~~,~~ and the major risk(s) associated with the waste.

Personnel access into the immobilized glass waste container storage areas will be limited and controlled administratively. Signs designating the hazards associated with the immobilized waste glass will be posted at appropriate locations outside the container storage areas.

Miscellaneous Mixed Waste Containers

The miscellaneous mixed waste containers will be labeled with the accumulation or generation start date, as appropriate, the major risk(s) associated with the waste, and the words "hazardous waste" or "dangerous waste". A waste tracking and inventory system will be implemented. Labels and markings will be positioned so that required information is visible. The label will meet the WAC 173-303-630(3) requirements, and the dangerous waste number will be clearly identified.

The labels on the overpack for the spent ~~or failed~~ melters will carry the accumulation or generation start date, the major risk(s) associated with the waste, and the words "hazardous waste" or "dangerous waste". A waste tracking and inventory system will be implemented. Labels and markings will be positioned so that required information is visible, and the dangerous waste number will be clearly identified.

Miscellaneous Dangerous Waste Containers

The miscellaneous dangerous waste drums will be labeled with the accumulation or generation start date, as appropriate, the major risk(s) associated with the waste, and the words "hazardous waste" or "dangerous waste". A waste tracking and inventory system will be implemented. Labels and markings will be positioned so that required information is visible. The label will meet the WAC 173-303-630(3) requirements, and the dangerous waste number will be clearly identified.

4.2.1.4 Containment Requirements for Storing Waste [D-1d]

~~The wastes managed in the immobilized waste container storage areas, and the limited amount of other materials present in the majority of the container storage areas, do not require secondary containment, as discussed below~~Secondary containment requirements for the waste managed in the immobilized waste container storage areas and the limited amount of other materials present are discussed below.

4.2.1.4.1 Secondary Containment System Design [D-1d(1)]

Secondary containment is required for areas in which containers hold free liquids. It is also required for areas managing wastes exhibiting the characteristics of ignitability or reactivity as defined in WAC 173-303-090(5) and (7).

~~ILAW and~~ IHLW

~~Secondary containment is required for areas in which containers hold free liquids. It is also required for areas managing wastes exhibiting the characteristic of ignitability or reactivity as defined in WAC 173-303-090(5) and (7). These~~ Secondary containment requirements do not pertain to the ~~ILAW and~~ IHLW (canister) container storage areas, as these ~~containers~~ canisters will not contain free liquids or wastes that are designated ignitable or reactive.

Miscellaneous Mixed Waste

~~Secondary containment is required for areas in which containers hold liquids. It is also required for areas managing wastes exhibiting the characteristic of ignitability or reactivity as defined in WAC 173-303-090(5) and (7). It is anticipated that miscellaneous mixed waste will not contain liquids; therefore, these requirements should not pertain to the WTP container storage areas, with the exception of the central waste storage facility. However, in the event that wastes containing liquids or wastes exhibiting the characteristics of ignitability or reactivity are generated, portable secondary containment that meets the requirements of WAC 173-303-630(7) will be provided~~Miscellaneous mixed waste storage areas may contain waste requiring secondary containment. If wastes containing liquids or wastes exhibiting the characteristics of ignitability or reactivity are generated, portable secondary containment that meets the requirements of WAC 173-303-630(7) will be provided.

~~The central waste storage facility may receive wastes that contain liquids or are incompatible. The central waste storage facility will be designed to meet the secondary containment requirements of WAC 173-303-630(7), and will include a protective coating on the floor, berms, sloped floors, sumps, and/or portable secondary containments. Wastes that do not contain free~~

~~liquids or other disqualifying wastes will not require secondary containment. Incompatible waste will be managed in accordance with appropriate requirements.~~

Miscellaneous Dangerous Waste

~~Wastes that do not contain liquids or other disqualifying wastes will not require secondary containment. Containers with liquids will be provided with secondary containment in the form of portable secondary containments made of high-density polyethylene or equivalent material to ensure containment. The secondary containments will have a capacity that meets the requirements of WAC 173-303-630(7), and will have a two-way forklift entry~~The non-radioactive dangerous waste storage area may contain waste requiring secondary containment. If wastes containing liquids or wastes exhibiting the characteristics of ignitability or reactivity are generated, portable secondary containment that meets the requirements of WAC 173-303-630(7) will be provided.

4.2.1.4.2 System Design [D-1d(1)(a)]

~~ILAW~~

~~There will be two container storage areas for the ILAW containers in the LAW vitrification plant, as follows:~~

- ~~ILAW buffer container storage area~~
- ~~ILAW container storage area~~

~~Both the ILAW container storage areas will be located in the LAW vitrification plant, which is designed to be seismically qualified, as outlined in Supplement 1. A secondary containment system will not be needed because the immobilized glass waste will not contain liquid. In addition, because liquid is not expected within the ILAW container storage area, the floor will not be sloped and will not contain drains or sumps.~~

~~Liquid will not be present within the ILAW container storage areas for the following reasons:~~

- ~~Administrative controls will ensure liquid does not enter or condense inside filled ILAW containers~~
- ~~The ILAW container storage areas will be completely enclosed within the LAW vitrification plant~~
- ~~The roof of the LAW vitrification plant will be metal roofing, roof insulation, and a vapor barrier~~
- ~~Penetrations to the storage areas will be sealed to prevent water ingress~~
- ~~Rainwater will be directed away, using roof drains~~

~~Schematics of the ILAW container storage areas are shown in Appendix 4A.~~

IHLW

There will be one container storage area for the IHLW ~~containers~~ canisters in the HLW vitrification plant, as follows:

- IHLW ~~container~~ canister storage ~~area~~cave (H-0132)

The IHLW ~~container~~ canister storage ~~area~~ cave will be located in the HLW vitrification plant, which is designed to be seismically qualified, as outlined in ~~Supplement 1~~DWP Attachment 51, Supplement 1. A secondary containment system will not be needed because the immobilized glass waste will not contain liquid. In addition, because liquid will not be present in the IHLW container storage area, the floor will not be sloped and will not contain drains or sumps.

Liquid will not be present within the IHLW container storage area for the following reasons:

- Administrative controls will ensure that liquid does not enter ~~or condense~~ inside filled IHLW canisters~~containers~~
- The IHLW container storage area will be completely enclosed with a metal roof
- Penetrations to the storage area will be sealed to prevent water ingress
- Rainwater will be directed away using roof drains

~~A schematic drawing depicting t~~The location of the IHLW container storage areas are shown on general arrangement drawings ~~is shown~~ in DWP ~~Appendix 4A~~Attachment 51, Appendix 10.4.

~~ILAW~~

~~There will be one container storage area for the ILAW canisters in the LAW vitrification plant, as follows:~~

~~ILAW canister buffer storage area (L-B025C/D)~~

~~The ILAW container storage area will be located in the LAW vitrification plant, which is designed to be seismically qualified, as outlined in Supplement 1. A secondary containment system will not be needed because the immobilized glass waste will not contain liquid. In addition, because liquid will not be present in the ILAW container storage area, the floor will not be sloped and will not contain drains or sumps.~~

~~Liquid will not be present within the ILAW container storage area for the following reasons:~~

~~Administrative controls will ensure that liquid does not enter inside filled ILAW canisters~~
~~The ILAW container storage area will be completely enclosed with a metal roof~~
~~Penetrations to the storage area will be sealed to prevent water ingress~~
~~Rainwater will be directed away using roof drains~~

~~A drawing depicting the location of the ILAW container storage area is shown in Attachment 51.~~

Miscellaneous Mixed Waste

There will be ~~six~~ four miscellaneous mixed waste (secondary waste) container storage areas at the WTP, as follows:

- ~~LAW container storage area~~
- HLW ~~ccontainer storage area 1~~East corridor El. 0 ft² (HC-0108/09/10)
- HLW ~~container storage~~loading area ~~2~~(H-0130)
- ~~HLW container storage area 3~~
- ~~Central waste storage facility~~
- ~~HLW out-of-service~~Failed melter storage facility
- ~~LAW out-of-service melter storage facility~~
- Laboratory waste management area (A-0139 and A-0139A)

~~The LAW container storage area, and t~~The HLW waste container storage areas will be located within the ~~LAW or~~ HLW vitrification plants~~, respectively~~. The laboratory waste management area will be located within the analytical laboratory. Therefore, these units will be completely enclosed within the plants, which will have metal roofing, roof insulation, and a vapor barrier. Penetrations to the storage areas will be sealed to prevent water ingress, and rainwater will be directed away using roof drains.

~~The central waste storage facility will be a metal-sided building with a concrete floor sloped to a grated sump. Secondary containment sumps will be provided for individual containers. The perimeter of the concrete floor will be curbed. Access to the building will be through two rollup doors capable of allowing forklift access, and one personnel door. It will have a metal roof, concrete floor, and concrete block walls. The floor and lower portion of the walls will be covered with a protective coating. The floor will be sloped to a grated sump.~~

The ~~HLW out-of-service~~failed melter storage facility will be used primarily to manage HLW ~~melters~~ Melters that have completed their useful service life. These units will be received in carbon steel overpack containers allowing limited hands-on contact. These overpacks will not be opened while the waste melters are located in this storage facility. The facility is capable of storing up to three waste melters at any given time. The ~~out-of-service~~spent HLW ~~melters~~ Melters will not be stacked.

The ~~HLW out-of-service~~failed melter storage facility may also receive containerized miscellaneous mixed waste ~~similar to that managed in the central waste storage facility~~, if needed. These waste containers will be sealed prior to transport to the ~~HLW out-of-service~~failed melter storage facility. The containers will not be opened while at this storage facility. The waste containers will not be stacked more than two containers high. The ~~HLW out-of-service~~ failed melter storage facility will be a stand-alone building located in the southern portion of the WTP.

~~The LAW out-of-service melter storage facility will be a stand-alone building located in the southern portion of the WTP. The LAW out-of-service melter storage facility will be a prefabricated metal building anchored to a reinforced concrete foundation. The floor will be covered with a protective coating and sloped to a grated sump. The LAW out-of-service melter storage facility will be used primarily to manage LAW melters that have completed their useful service life. The integral shielding of the locally shielded melter allows hands-on contact. The facility is capable of storing up to two waste melters at any given time. The waste LAW melters will not be stacked.~~

~~The LAW out-of-service melter storage facility may also receive containerized miscellaneous waste similar to that managed in the central waste storage facility (no waste containing liquids, no ignitable or reactive waste will be stored at this facility). The containers will not be opened while at this storage facility. The waste containers will not be stacked more than two containers high.~~

Miscellaneous Dangerous Waste
Waste containing liquid may be present in the non-radioactive dangerous waste storage area. Containers with liquids will be provided with portable secondary containment ~~in the form of portable secondary containments made of high-density polyethylene or equivalent material to ensure containment. The secondary containments will have a capacity that meets~~meeting the requirements of WAC 173-303-630(7)~~, and will have a two-way forklift entry~~.

4.2.1.4.3 Structural Integrity of the Base [D-1d(1)(b)]

The storage areas will be constructed to support storage and transportation of containers within the container storage areas and will be designed with the following:

- Containment system capable of collecting and holding spills and leaks
- Base will be free of cracks and gaps and sufficiently impervious to contain leaks
- Positive drainage control
- Sufficient containment volume
- Sloped to drain or remove liquid, as necessary

4.2.1.4.4 Containment System Capacity [D-1d(1)(c)]

~~ILAW and~~ IHLW
Because liquids will not be present in the containment system ~~for these three two units~~IHLW storage areas, a containment system capacity demonstration is not required.

Miscellaneous Mixed Waste
The ~~LAW container storage area and the~~ HLW container storage areas do not require secondary containment because storage of liquids in these units is not anticipated. If the waste is found to contain liquid, portable secondary containment will be provided that meets the requirements of WAC 173-303-630(7). The waste container will function as the primary containment while the

portable containment device will function as the secondary containment. Each portable secondary containment will have the capacity to contain ~~ten percent~~10 % of the volume of all containers within the containment area, or the volume of the largest container, whichever is greater.

Liquid waste may be stored in the laboratory and waste management area. Each container holding liquid dangerous waste will be placed into portable secondary containment that meets the requirements of WAC 173-303-630(7). The waste container will function as the primary containment while the portable containment device will function as the secondary containment. Each portable secondary containment will have the capacity to contain ~~ten percent~~10 % of the volume of all containers within the containment area, or the volume of the largest container, whichever is greater.

~~Liquid waste may be stored in the central waste storage facility. Secondary containment will will have the capacity to contain ten percent of the volume of all containers or the volume of the largest container, whichever is greater.~~

Miscellaneous Dangerous Waste
Waste containing liquid may be present in the non-radioactive dangerous waste container storage area. Each container holding liquid non-radioactive dangerous waste will be placed into portable secondary containment. The waste container will function as the primary containment while the portable sump will function as the secondary containment. Each portable secondary containment will have the capacity to contain ~~ten percent~~10 % of the volume of all containers within the containment area, or the volume of the largest container, whichever is greater. Typically, the waste containers will be ~~in~~ steel drums.

4.2.1.4.5 Control of Run-~~o~~On [D-1d(1)(d)]

~~ILAW and~~ IHLW
The ~~ILAW and~~ IHLW container storage areas will be located in the ~~LAW and~~ HLW vitrification plants. The requirements for this section do not apply because the immobilized glass waste container storage areas are within the vitrification plants and therefore will not be exposed to run-on.

Miscellaneous Mixed Waste
Run-on will not reach the interior of the miscellaneous mixed waste storage areas, because they will be located within buildings, which will have roof gutters to remove precipitation.

Miscellaneous Dangerous Waste
Run-on will not reach the interior of the ~~miscellaneous~~ non-radioactive dangerous waste container storage area, because ~~it will be a stand-alone~~ waste will be managed in buildings with walls and roof ~~gutters~~ to remove precipitation.

4.2.1.4.6 Removal of Liquids from Containment System [D-1d(2)]

~~ILAW and~~ IHLW

No liquids will be present in the containment system; therefore, the requirements of this section do not apply to the immobilized waste glass container storage areas.

Miscellaneous Mixed Waste

Portable secondary containment sumps will be provided for individual containers that contain liquids. Hand pumps or similar devices will be used to remove liquid released to the portable secondary containments.

Miscellaneous Dangerous Waste

Portable secondary containment sumps will be provided for individual containers that contain liquids. Hand pumps or similar devices will be used to remove liquid released to the portable secondary containments.

4.2.1.4.7 Demonstration that Containment is not Required because Containers do not Contain Free Liquids, Wastes that Exhibit Ignitability or Reactivity, or Wastes Designated F020-023, F026 or F027 [D-1e]

~~ILAW and~~ IHLW

The ~~ILAW and~~ IHLW glass ~~container/~~canister storage areas will not contain liquids. The vitrification process volatilizes water or other liquid materials existing at ambient conditions in the waste slurry feed that enters the melter.

The waste numbers for ignitability (D001) and reactivity (D003) will not be managed in the immobilized glass container storage areas. Wastes with the F020-F023, F026, and F027 numbers are not identified for the DST system unit. Therefore, these waste numbers will not be present at the WTP.

Miscellaneous Mixed Waste

Liquids may be present in wastes in the ~~central waste storage facility, and the miscellaneous dangerous~~ laboratory waste ~~container storage~~management area. Secondary containment will be provided for individual containers that manage liquids. ~~The waste numbers for ignitability (D001) and reactivity (D003) will not be managed in the miscellaneous mixed waste storage areas~~The laboratory waste management area may manage D001 and D003 waste. Wastes with the F020-F023, F026, and F027 numbers are not identified for the DST system. Therefore, these waste numbers will not be present at the WTP.

Miscellaneous Dangerous Waste

The ~~miscellaneous~~ non-radioactive dangerous waste container storage area may manage liquids and D001 and D003 waste; therefore, secondary containment will be provided. Wastes with the F020-F023, F026, and F027 numbers are not identified for the DST system unit. Therefore, these waste numbers will not be present at the WTP.

4.2.1.5 Prevention of Reaction of Ignitable, Reactive, and Incompatible Wastes in Containers [D-1f]

Ignitable, Reactive, or Incompatible ~~ILAW and~~ IHLW
Immobilized glass waste will not be ignitable, reactive, or incompatible with the wastes managed in the ~~ILAW and~~ IHLW ~~container~~ canister storage areas. The requirements of this section are not applicable to the immobilized glass waste containers, including spent ~~or failed~~ melters.

Ignitable, Reactive, or Incompatible Miscellaneous Mixed Waste and Miscellaneous Dangerous Waste
Potentially incompatible wastes are not expected to be managed in the miscellaneous mixed waste storage areas, except for the laboratory waste management area and the non-radioactive dangerous waste container storage area. If such wastes are managed ~~here~~in one of these areas, the containers of incompatible waste or chemicals will not be stored in close proximity to each other. Acids and bases will be stored on separate portable secondary containment sumps; oxidizers will be stored in areas separate from combustible materials; and corrosive chemicals will be stored on a separate secondary containment sump. These separate storage areas within the unit will be clearly marked with signs indicating the appropriate waste to be stored in each area. Potentially incompatible waste will be stored at least one aisle width apart.

4.2.2 Tank Systems [D-2]

This section contains descriptive information for each tank system used for managing mixed waste. The term "tank systems" refers to mixed waste storage or treatment tanks and their associated ancillary equipment and containment systems. Figures and permit drawings depicting design features of ~~typical~~ tank systems are found in DWP ~~Appendix 4A~~Attachment 51.

The following text uses the terms "vessel" and "tank". The term "vessel" is an engineering term and denotes more robust construction than a typical mixed waste storage or treatment tank. The term "vessel" is included due to the use of the term in the American Society of Mechanical Engineers (ASME) codes and specifications, which will be followed~~,~~ for most tank construction at the WTP.

4.2.2.1 Design, Installation, and Assessment of Tank Systems [D-2a]

This section describes the attributes of tank systems that will contain mixed waste. Tanks and ancillary equipment containing only additives or reagents, such as glass-forming chemicals, precipitation reagents, or unused resin, are not regulated under RCRA or the Washington State Dangerous Waste Program, and are therefore not included.

Tank systems that will contain mixed waste are designed to comply with worst-case scenarios, such as extreme pH, temperature, and pressure conditions. The WTP will be entirely new construction, and there will be no "existing tanks" in the plant. Tank systems, with the exception of the two outside tanks at the pretreatment plant, will be located indoors and within process cells, process rooms, or caves with controlled access.

4.2.2.1.1 Design Requirements [D-2a(1)]

Tanks

Most of the tanks ~~which~~ that come in contact with the waste will be operated under atmospheric pressure conditions at the WTP. The mixed waste tanks will be designed, at a minimum, to *Boiler and Pressure Vessel Code* (ASME 2000), the American Petroleum Institute (API) codes, or other appropriate design codes. Tank integrity will be reinforced by additional requirements of the tank group and seismic category assignment to each tank. ~~Five vessel or tank groups will be designated to accommodate the variations in design criteria and safety requirements of the WTP. Groups 1 through 3 will be high-integrity vessels and will be located within cells or caves. Group 4 will be medium-integrity and Group 5 will be constructed to commercial standards. Some general vessel or tank design requirements are summarized as follows:~~

- ~~The approximate minimum thickness of uncorroded cylindrical shell and dished head will be determined based on the vessel diameter.~~
- ~~The minimum anchor bolts, where used, will be 0.75 in. in diameter, Unified National Code (coarse thread) bolts.~~
- ~~Three types of tank supports may be used: skirts, saddles or legs.~~
- ~~Minimum wall thickness for a nozzle neck or other connection (including access and inspection openings) will comply with the requirements of ASME Code paragraph UG-45 (ASME 1996).~~

The vessels will be designed for seismic loading in accordance with the *Uniform Building Code* (UBC) standard for Zone 2B (UBC 1997).

The codes and standards that will be followed for design, construction, and inspection for the tanks are identified below, as applicable:

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society of Non-Destructive Testing
ASTM	American Society ~~of~~ for Testing and Materials
EPA	US Environmental Protection Agency
NBBPVI	The National Board of Boilers and Pressure Vessel Inspectors
OSHA	Occupational Safety and Health Administration
PFI	Pipe Fabrication Institute
UBC	*Uniform Building Code*
WRC	Welding Research Council

Permit documents describing tank design requirements are located in DWP Attachment 51, Appendix 7.7~~and include~~: